PRODUCTION AND FACTORY EQUIPMENT ISSUE

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Automotive Industries

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Simplification is the Keynote In Production *Management*

Present high state of efficiency has been based on a gradual growth in operations, with the application of common sense in connection with higher standards of accuracy.

By E. KARL WENNERLUND
Director, Factory Engineering Section, Works Managers Committee, General Motors Corp.
As told to
ATHEL F. DENHAM

WHAT lies over the production horizon? The best answer to that question probably is found in a study of the past and the present. We haven't reached our present high state of production efficiency as the result of sudden leaps or specific steps. It has been a gradual growth based chiefly on the application of common sense, simplification, and higher standards of accuracy. In addition, we have had many mechanical developments, and we will have more in the future, some of which we cannot even foresee at present, new tools and processes, new materials which will cut costs and give us better products—in short a continuation of production progress which has been going on for years.

E. Karl Wennerlund

A number of new developments, however, are already under way. It is quite possible that the new tungsten-carbide cutting steels may revolutionize the art of metal cutting. If they do, they will bring with them major changes in machine tool design.

New steel developments and applications may have important effects in relation to production methods and costs. As an example, we have the application of steels not requiring heat-treating after leaving the forge shop, such as the chrome-vanadium and manganese molybdenum steels now being introduced for crankshafts and connecting rods.

Other steels will reduce our material cost. The aluminum alloy steel for valves, for instance. Stainless steels also hold considerable promise for the future, provided their price can be substantially reduced.

Of these, the tungsten-carbide steels and their influence on production are perhaps of the most vital interest. From our limited experience with the new alloys in this country alone, it already appears evident

PRODUCTION AND FACTORY EQUIPMENT

IN this issue of *Automotive Industries*, a number of highly important topics in production and factory equipment fields have been covered. In addition to this, however, we have been able to publish a cabled report of the automobile show in Paris (Page 555), a description of the Machine Tool Show in Cleveland, which was previewed in the issue of September 21, and the production meetings of the American Society of Mechanical Engineers, and the Society of Automotive Engineers (Pages 539 to 554 inclusive), held in connection with the Second Machine Tool Congress and the National Machine Tool Builders Assn. Exposition.

that their extensive introduction will necessitate the development of new machine tools adapted specifically to their use, as was the case a number of years ago when high speed cutting steels were first introduced. In fact, we are more or less in the same position with respect to the tungsten-carbide steels now as we were then in relation to high speed steels. The manufacturers attempting to introduce these steels prevailed on factories to try them here and there. They were tried out on machine tools which then were designed for carbon steel. As a result we had plenty of trouble. It wasn't until the machine tool manufacturer took a hand in the game and developed tools specifically adapted to the high speed steels, either at the request of factories, or on their own initiative, that we began to get somewhere.

Exactly the same condition exists today with tungsten carbide. Machine tool manufacturers are holding back, not knowing the market possibilities. The actual trend which machine tool design will take with the adoption of these steels is more difficult to forecast. For hogging forgings and castings, we shall probably need a wider application of hydraulic feeds due to the hardness and brittleness of the new alloys. For finishing cuts, higher spindle speeds appear necessary. More rigid tool supports and machine beds of greater strength are likely to predominate in the design and equipment of new machine tools. Research on tool tip shapes, methods of brazing or welding the new alloys, and development of abrasive wheels for grinding, naturally will accompany their widespread introduction. Automatic lubrication of machinery, with its attendant reduction in maintenance cost, is further indicated for the future.

System Has Its Place

In the early days of industrial development, production was more or less haphazard. The system became the byword," E. K. Wennerlund states in the accompanying article. "But the swing of the pendulum carried many an organization too far, resulting in the loss of the main purpose in the detail systematization itself.

"It is now realized that system has its place only where it simplifies production routine. The systematizer-for-the-sake-of-system has been replaced by the practical man who applies system as a method of simplifying control."

Intangible Factors

Aside from these things, there is much of a less tangible nature that is being done to increase our production efficiency. Simplification is the keynote today. In the early days of industrial development production was more or less haphazard. The system became the byword, but the swing of the pendulum carried many organizations too far in that direction. System became a fetish in many cases, which resulted in losing sight of the main purpose in the detail systematization itself. When applied to large organizations, it just got so big that it was beyond handling.

The relatively high cost of handling a wage incentive system on an individual basis led us to develop and adopt quite generally the group plan of wage payment. It was found that some of our plants had as many as 25,000 job tickets a day, all of which had to be extended, audited and credited to individual accounts. Under the group plan we have been able to do away with job tickets, using only the in-and-out clock cards and giving credit for finished good product. This has been a great saving in clerical detail in our factories, it has cut inventories of work-in-process, and has on the whole stimulated production efficiency.

It is now realized that system has its place only where it simplifies production routine. As a result, the systematizer-for-the-sake-of-system has been replaced by the practical man who applies system as a method of simplifying production control.

Materials control is a good example. Here there was a tendency in the past to systematize down to the last detail. Nowadays we use less system and greater accuracy in scheduling and adherence to schedules. We finish our final designs of new models well in advance of production. That enables us to work out our material requirements. When we go into production, management sets definite schedules and tries to adhere to them. Engineering design is changed only reluctantly thereafter and only when absolutely necessary.

The cumulative method of control of buying over a year's production, and of inventory control by means of shipping orders based on definite production schedules was made easier thereby, with a simultaneous reduction in the need for stockroom clerks and expensive stock records. If we want to know how many parts we have on hand, in a car plant, all we need to do is to subtract the number used in the finished products built to date from the number received, making allowances for service withdrawals and defectives. The necessity for express shipments is considerably reduced and often entirely eliminated.

Proper inventory control, incidentally, is a production cost factor which a surprising number of companies have not given the attention which it merits, in spite of the fact that it sometimes may mean the difference between profit and loss. Just recently an old established automobile company was carrying an inventory of roughly $4,000,000. One of our men got a job with them on the promise that he would cut their inventory in half. He did even better than that and this company is saving over $120,000 a year in interest alone, with interest at six per cent.

Reducing inventory costs does not necessarily mean setting up a control system to cover every part going into the finished product. In an automobile plant, there are roughly three classes of materials. First, a group of from 50 to 60 items representing 80 to 85 per cent of the material investment and requiring the closest control. The second group, consisting of forgings and castings generally can be controlled sufficiently by monthly shipping schedules. The third, or miscellaneous group, comprises the largest number of parts, but represents such a relatively small proportion of the total investment that it can be ordered well in advance, without serious effect on the total inventory cost.

Overhead Costs

Relative costs also underlie the equipping of our factories for day and night shifts. We might, for example, provide sufficient production capacity in machine tools to make a night shift unnecessary. But if we do this our overhead goes up not only in actual investment dollars, but in percentage of overhead per unit manufactured. Unless a machine tool is kept busy money is being wasted.

Machine tool manufacturers have further assisted us

in reducing our equipment cost by commercializing special purpose tools, with the consequence that individual special design tools are much less frequently used. Some of our largest automobile manufacturers, for instance, use very few specially designed machines. Of course, in organizations manufacturing a highly specialized product, special design tools are being used and probably will continue to be used, chiefly because machine tool manufacturers do not find it profitable to develop commercially tools for this character of work, considering the limited market possibilities. Even in the specialized parts business, however, we find a gradual tendency away from the special design tool and toward the commercial, with its greater flexibility and lower investment cost.

Our increased reliance on the machine tool manufacturer is also evidenced in other directions. He contributes much in tooling up our shops. Our factory organization is too busy to make all details of tool and equipment design. If a particular operation is not suitable for his particular equipment, the progressive machine tool manufacturer says so. Machinery is not so much sold as it is bought. Because of this, together with the accumulation of definite and accurate production information, the position of the purchasing agent in the acquisition of equipment has become more that of an intermediary. Equipment is now specified almost universally by production men and tool engineers according to make, with not much option as to source of supply.

Machine tools are now bought, also, on the basis of actual production needs rather than on maximum capacity. They are required to give a definite production rate with maximum economy of investment. In one of our plants we found we had a group of four machine tools representing an investment of $75,000. They had such high production capacity that they were busy only a few weeks in the year. That isn't economy. Excessive production capacity may mean an actual waste.

Budget Necessities

In buying our productive materials, it has long been customary to buy on specification; but even here, the search for greater accuracy has led us to change our bases for specifications and acceptance. Every shipment of material is subjected to inspection and often to chemical and tensile tests. We are devising tests and inspection methods, generally, that will have a more direct bearing both on the process to which the material is to be subjected and on the final result desired. In this connection, machinability measuring devices simple in character and operation are possibly an interesting development for the near future.

As far as factory supplies and perishable tools are concerned, we are just awakening to the necessity of "budgeting." Waste elimination campaigns have been run, and they serve their purpose in that they show what can be accomplished. But they are not sufficient. We must sit on the lid, and that requires organized effort. There are many manufacturers who have no idea of how much money they are spending on this end of the business, much less how much they could save by proper control. Hand in hand with this goes buying on specification and in accordance with production volume.

Such changes in factory operation have naturally brought with them corresponding changes in organization. First, we find a relatively new development, the staff specialist. He determines just how much more we can produce under a given set of conditions than we are producing. For instance, in the past, the average production man concentrated his attention chiefly on reducing the cost of individual operations, or sequence of operations, on a given part. We needed also to study the effect on production costs of generalized design. As an example, here in the corporation we have been spending several millions yearly on buffing and polishing alone. A study shows us that we can cut that considerably by eliminating sharp corners, aside from the reduction in die and plating costs. This may be taken as an example of the production man's growth of influence on the final design of the finished product.

Control and Costs

"Proper inventory control is a cost factor which a surprising number of companies have not given the attention which it merits, in spite of the fact that it sometimes may mean the difference between profit and loss," Mr. Wennerlund finds.

"Relative costs also underlie equipment of factories for day and night shifts. We might provide sufficient productive capacity in machine tools to make a night shift unnecessary. But if we do this our overhead goes up not only in actual investment dollars, but also in percentage of overhead per unit made.

"Unless a machine tool is kept busy, money is being lost."

Foreman Training

Much has been said about foreman training of late. To my mind, some of the plans suggested call for much that is of little practical value. It would not increase the foreman's efficiency to teach him purely cultural subjects. Teaching him how to draw does not necessarily make him a better foreman. What he needs is education along the lines of understanding his job a little better, how to be neat and orderly, obtaining his men's respect and confidence, and the necessity of his being sympathetic with them. We don't run our plants primarily to develop managers, we are in business to produce.

Coming now to the working man, our chief problem, of course, is labor stabilization. Stabilizing production, as desirable as it may be, is not the complete economic solution with the present set-up. That involves tying up much money in merchandise inventory during slack sales seasons, especially where the product is bulky and costly and requires considerable storage space. Aside from this there is the influence of model changes necessitated by competitive conditions of style trends.

The working man is given more consideration today than ever in the past. In progressive plants, the curtailing of working hours in off seasons is preferred as an alternative to the complete laying off of many men, and full time operation for the rest. We have gone to the expense of building up highly trained personnel departments to properly select our employees, and we use every reasonable means to keep them steadily in our service. No foreman is allowed to discharge an employee without investigation.

Giving workers the opportunity to invest in the company by which they are employed, and the company itself adding to that investment, is a further aid to labor stabilization.

Short Cuts on Standard Machines Are Being Developed *to Reduce*

New "kinks" in operation, new attachments, are being dis prove quality, increase

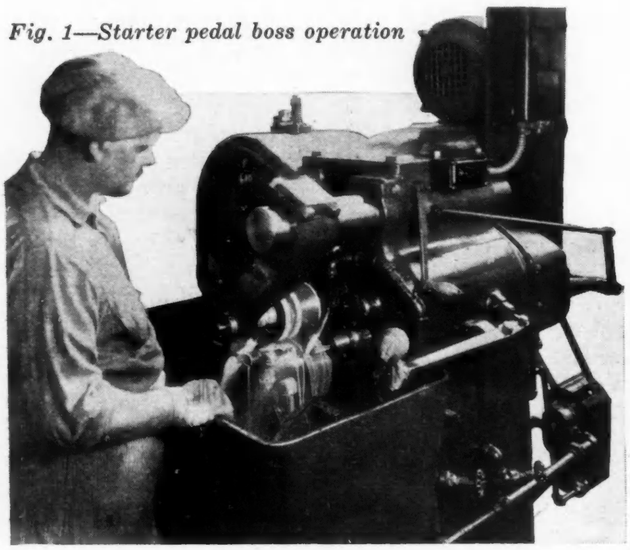


Fig. 1—Starter pedal boss operation

EVERY corner of modern automotive plants yields to the investigation of the trained observer some new "kink" that serves to reduce cost, produce better quality or increase output. New ways in which certain factories are performing certain common automotive jobs are described in the following pages, the material for which was selected from a mass of data gathered in actual study of hundreds of special operations at the factories in the last few months.

It is interesting to observe the marked increase in attachments designed to make fully automatic a complete cycle of operations on one machine. A striking example of this is a circular indexing fixture which is used to drill tap holes in the horizontal and vertical faces of certain parts. The entire cycle is automatic from start to finish, the operator's duty being limited to loading and unloading the fixtures. An operation of this nature

Starter Pedal Boss Operation

THE illustration in Fig. 1 shows an interesting operation on a new milling machine at Plymouth. The set-up is to mill, drill and ream the starter pedal boss in one setting of the machine without handling.

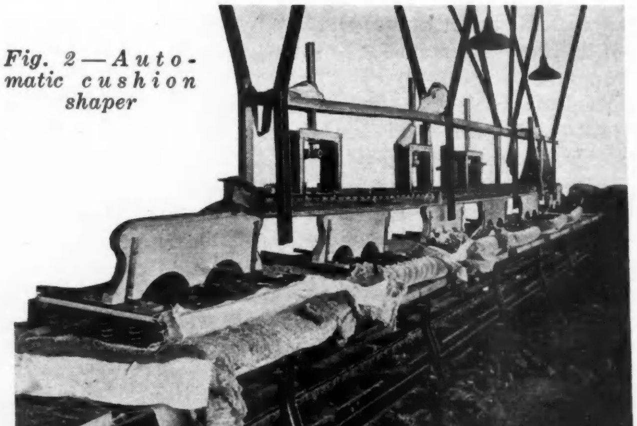
The operation begins at the center where the faces of the boss are finished in passing between two milling cutters. The fixture indexes to the left, comes to a stop, and at this point a drill is timed to feed through. As the drill recedes the fixture begins to move to the extreme right. In passing through the center position the burr left by the drill is cleaned off. The fixture now stops at the right where the reamer is timed to feed in. When the reamer recedes the pedal is removed and the fixture is loaded again. Production is 200 pieces per hour.

Making Seat Cushions

IT is customary, while trimming seat cushions, to have the cushion springs under a predetermined compression. This detail is important because the upholstery material must be stretched just the right amount if it is to retain its shape under service conditions. Improper amount of compression, moreover, results in a tendency to pull out the tacks when compression is released. As a rule the spring cushion is compressed in a special fixture while the trimmer works on it.

But Durant has made a big stride forward by providing automatic pressure regulation in conjunction with the platform conveyor shown in Fig. 2.

Fig. 2—Automatic cushion shaper



The cushion with its trimming material is placed on the conveyor and the wooden fixture shown at the extreme left is set on it. As the conveyor advances, the wooden fixture, which has a metal rail on top, slides into the opening between the channel iron and moves along in contact with the rollers which can be seen just above the channel rail. Further movement of the conveyor compresses the seat cushion springs the right amount. Friction between the fixture and the rail is minimized by the action of the rollers.

An installation, similar in type but different in details of construction, has been put into operation recently by another well-known automobile manufacturer.

Machining Brake Lining

THE molded brake lining used on Plymouth brakes is machined after riveting to give the desired diameter and finish. The method finally adopted after con-

for Common *Automotive Jobs*
Use of Special Tools

types of fixtures and ingenious covered constantly to im- output and lower costs.

reduces handling to a minimum. Moreover, it assures interchangeability because all work is completed in one fixture with one setting.

The desire of most production men today to use standard machine tools has stimulated the development of new short cuts, new types of fixtures and ingenious attachments that get the job done better and faster than before. In fact, certain standard machines are tooled to handle parts which but a short time ago required expensive special machinery.

To gain a perspective of some of these new methods a study was made of a representative variety of operations. The principle underlying each of these is all the more valuable because, in most instances, it can be applied with modifications to many related problems in any automobile plant.

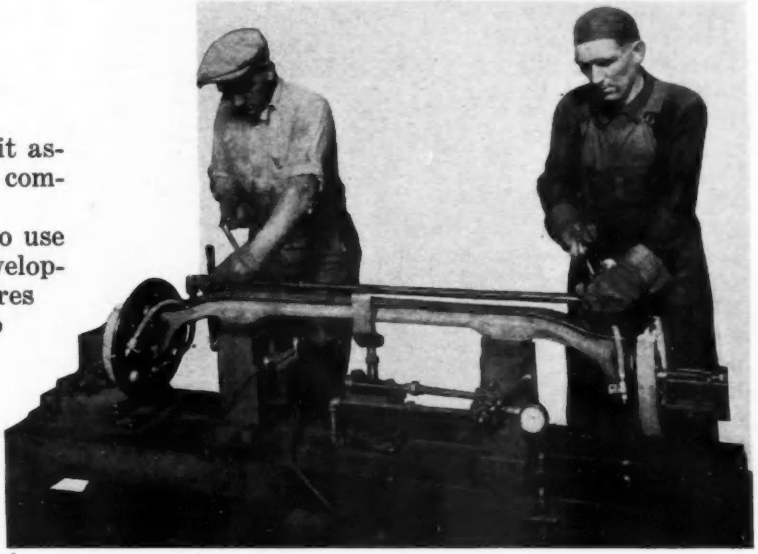


Fig. 4—Fixture for checking angle of steering knuckle

siderable experiment is the unusual machining operation shown in Fig. 3.

A converted wood-turning machine with a flat table and a vertical driving spindle which projects through from the under side is used. On this spindle is mounted a coarse tooth milling cutter with spiral teeth. The fixture is really the outstanding feature of this operation. It is full automatic and handles two shoes at a time. The operator lays in the two shoes and presses the starter button. Air operated clamps come down to hold the shoes, the circular fixture makes one revolution against the rotating cutter, comes to a positive stop and releases the air operated clamps to facilitate unloading.

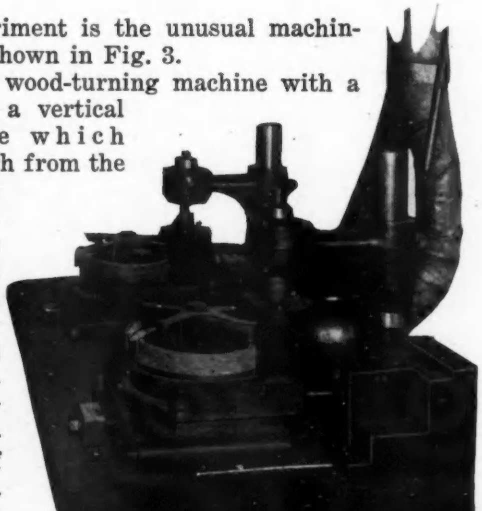


Fig. 3—Converted wood-turning tool for automatic machining of brake lining

The trend is toward full automatic operations to the last degree. Production is 1200 pieces per hr.

Tramming Front Axle

INSPECTION and production functions are ably combined in the process of checking toe-in at Plymouth. As the axle comes off the assembly line it is lowered on to the checking fixture (Fig. 4). An air-operated clamp holds it at the center. One steering knuckle is set into the fixed block at the left, at the correct angle. Then the other knuckle drops into the adjustable block at the right.

The effectiveness of this fixture lies in a novel telltale arrangement for indicating the correct adjustment at the movable block. A simple electrical circuit is employed. Two small red lamps are mounted on the base of the fixture, each connected to a stop at one side of the block. A red light indicates which side requires adjustment. The operator then adjusts the tie-rod until the circuit is broken. It is worth noting that the lamps indicate where to make the correction and show automatically when the operation is completed.

This is a production job but an inspector stands by and observes the operation, thus inspecting the axle as a matter of routine without further handling.

Unusual Spot Facing

MACHINING the inside bosses of the front spring bracket is ordinarily a milling operation requiring a milling machine, fixture and an operator. Graham-Paige not only has put this operation on a mass production basis but has arranged it to fill in idle time while three holes in the body of the bracket are being automatically drilled on an adjacent machine.

A study of the sectional drawing of the set-up

(Fig. 5) shows the interesting method developed. This fixture is installed on a standard drill press. The cutter (1) is mounted free to rotate in bearing (2). The spring bracket is fitted over the cutter and rests on stops on the table. Then the driving head (3) which has flats to engage in cutter (1) is fed in. As it feeds in it automatically lines up the bracket by piloting through the hole. During the downward movement the driving head engages the cutter and completes the spot facing operation as the head comes to a stop. The driving head is then retracted, the bracket removed and reversed to spot face the other boss. The unique feature of this operation is the way it fits into a comprehensive program for utilizing idle time.

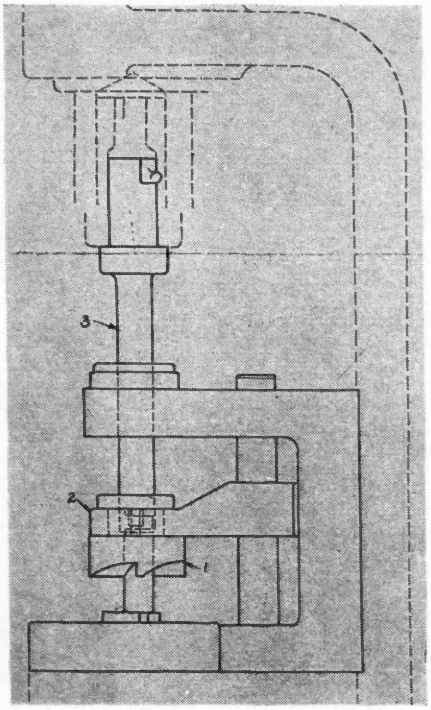


Fig. 5—Line drawing of spot-facing set-up

Estimated production is about 180 per hour.

Testing Valve Seats

MODERN production methods make valve grinding a routine operation. But the problem of checking the finished job for 100 per cent accuracy is not at all easy. Pierce-Arrow engineers have just perfected an ingenious method for inspecting the seating of valves. The set-up is simple and the operation is performed with facility as is evident from the illustration (Fig. 6).

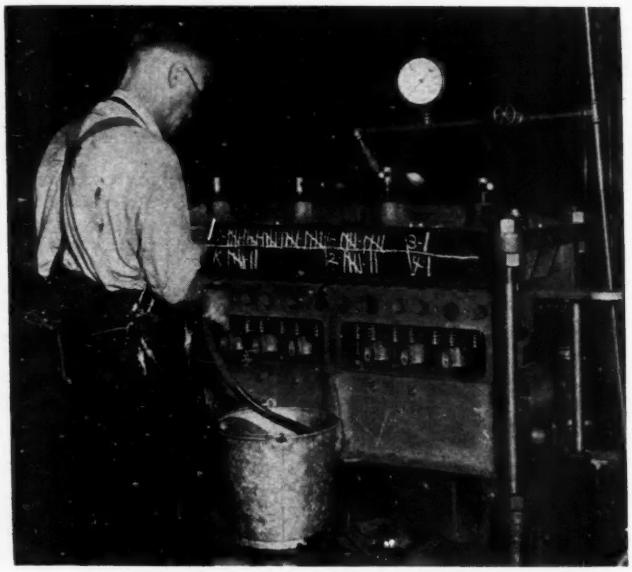


Fig. 6—Simple bubble test for valve seating

The apparatus consists of a special cylinder head, mounted above the conveyor, and connected to an air line adjusted to deliver about 80 lb. per sq. in. pressure. Cylinder blocks are advanced to the inspection bench with valves in place and held down by the valve springs. The head is lowered, clamped in place, and the air valve opened. On the bench is an ordinary pail filled with water. Clamped to its side is a rubber tube, one end of which is in the pail. The other end is free and carries at its extremity a steel ring with a live rubber insert to fit the valve port. The operator applies the ring at each port progressively and looks for bubbles in the water as an indication of a leak. Pierce-Arrow standards demand 100 per cent tightness. Every valve must pass this test without perceptible bubbling in the pail.

One man and one fixture are sufficient to keep the line moving.

Milling Big End of Rod

CONNECTING rods for the Viking 90-deg. V engine fit together in pairs on the crank pins. Because the steel faces of the big ends bear together, these surfaces must be smooth and accurately made. When production first was begun on these rods, this surface was milled with a standard end mill. Right then it developed that although the finish was smooth, there were concentric circles in the surface caused by picking up fine chips. Various forms of cutters were used and mounted in different ways, but the concentric circles were still present. This was objectionable because particles of foreign matter if picked up between the rods in operation might stay within these concentric paths and score the surfaces in contact.

After considerable research efforts were made at reciprocating the big end of the connecting rod by means of a short throw eccentric while milling. It is interesting to note that the concentric circles disappeared. The surface was still marked, but the circles developed into curved lines starting at the center and running out to the edge. This condition is satisfactory because now it is certain that if foreign matter does get in, it will be carried out at once. Another important discovery was made. Originally, the milling operation threw a burr into the polished bearing surface of the bore and this had to be carefully removed. With the new method the burr had disappeared.

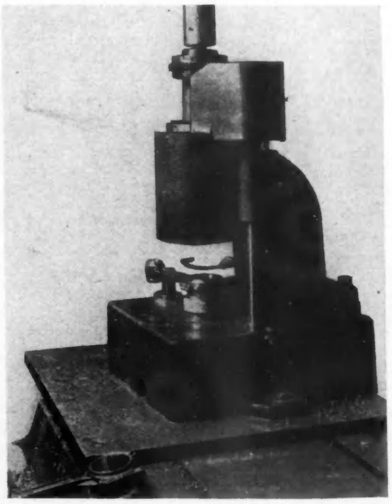


Fig. 7—Unit for milling connecting rod

For production the milling machine was equipped with a new table as shown in Fig. 7. The large stud holds the big end of the rod and reciprocates it by a suitable mechanism below. The small end of the rod is free and rests against a fixed stop which takes the thrust

of the milling cut. The principle involved is well worth noting. It is of course adaptable to many applications of the same general character. In another form it is being used successfully in honing operations.

Output on this installation is 220 rods per hour.

Fitting Washers on Screws

A SIMPLE machine designed by Ford men to do the work formerly done by 8 to 10 operators is shown in Fig. 8.

The new machine performs the humble service of placing washers on screws. Formerly, this was done by hand. When it is remembered that more than 55,000 of these had to be handled every day, it can be seen that the accomplishment of such a job by machinery was worth while.

As will be noted from the picture, the screws slide down a tilted incline from a square container, where they are automatically started in line by a hopper that empties into the chute. At the lower end they are seated by a set of jaws that set them in place, one at a time, into one of the openings in the circumference of a revolving drum. Just before the screw drops into the opening, a washer is fitted to the hole, sliding off the bottom of a perpendicular rod that, with its row of washers, stands upright over the drum.

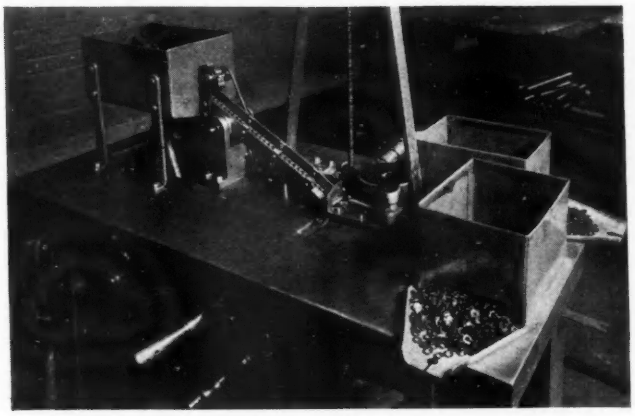


Fig. 8—Automatic device for putting washers on screws

When the screw drops into the hole, it is fitted to the washer. The screw then remains in position on the drum until it has revolved around to a point where it is released in such a way that it turns over and lands, head up, on an incline, opening onto a slotted tray. The latter consists of rows of grooves made to fit the screws, each tray capable of holding 2500 at a time.

Simple precautions have been taken to prevent jamming. If an odd-size screw gets into the chute it is thrown out by the automatic "kick-back" just outside the hopper at the top of the incline. The machine is spring-driven so that nothing can jam it. Currents of air are used to deliver the washers to the drum and to loosen the screws from it after it has revolved around to the point of release. These currents of air are supplied from the exhaust of the air-driven shaker.

Pressing-In Piston Pin Bushing

THE coordination of an inspection and production operation is skillfully developed by Packard in the machine illustrated in Fig. 9.

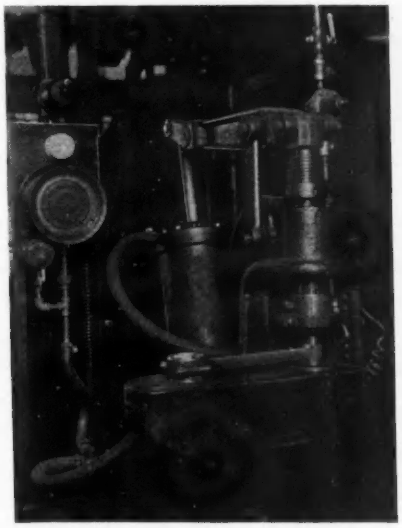


Fig. 9—Full automatic device which fits and inspects fit of pin bushing

The bushing is entered into the small end of the connecting rod and set under the air-operated plunger. The cycle is now full automatic. If the bushing fit is loose a red light shows on the panel at the right. If the fit is right, a white light shows. The lights are operated from the air pressure gage which makes electrical contact at predetermined points.

This is an instructive example of the use of indicator lights. It makes a quick production job out of a pretty difficult operation.

Checking Piston Rings

IN studying various phases of inspection processes, Graham-Paige engineers discovered that certain weighing scale operations induced fatigue resulting in eye strain which tended to affect either quality or output or both.

This problem was solved in an interesting way in checking the load required to compress the piston ring. A standard weighing scale (Fig. 10) is used to check the load with the ring compressed in the holder. As a rule, the operator inserts the ring, then notes the reading on the scale. It is the constant movement of the eye from the ring to the scale that induces fatigue. To overcome this two mirrors were mounted and focused so that the upper one reflects the scale into the lower

Fig. 10—Unique use of reflectors to assist in checking compression load on piston rings

where it is read on a level with the eye when inserting the ring.

This improvement, which is so readily adaptable to a standard weighing scale, has resulted in increased production and gives better quality control.

Inspecting Chromium Plated Parts

PACKARD has developed a method of visual inspection of chromium plated surfaces which shows up the most minute defect readily. The hood shown in Fig. 11 illustrates an application of the principle. It is coated with an aluminum paint and energized by reflected light from the top of the hood. Under this hood chromium plate shows up in its natural lustrous white finish. Nickel appears about the same as a spot of brass and shows up glaringly.

Fig. 11—Booth for inspection of chromium-plated parts

This method adds no burden to the inspection cost. It assures a chromium finish within specified limits.

Connecting Rod Shaving

THE Oldsmobile connecting rod has 10 boss and locating flat surfaces at the big end which must be finished to required dimensions. For a long time

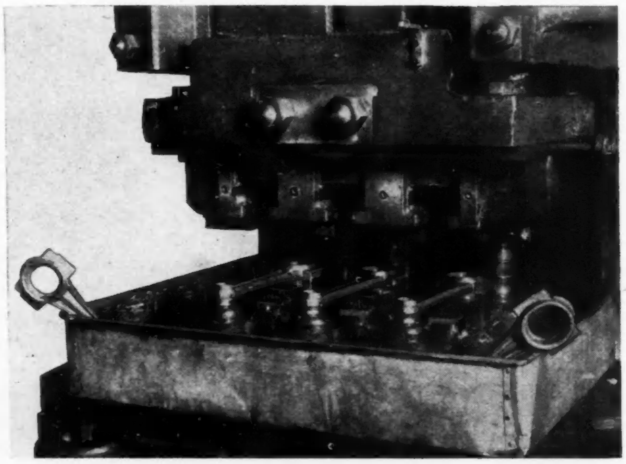


Fig. 12—Shaving operation on a punch press which is used in place of a complete milling job for finishing big end of connecting rods to required dimensions

these surfaces were finished as a milling operation. Later was developed the shaving operation on the punch press using three dies and three punches at one setting which is now in use and which is shown in the accompanying illustration (Fig. 12). Metal is removed in three stages so that each rod is moved progressively through the three dies.

Forming External Brake Band

A NOVEL production machine is used at Oldsmobile for forming the external wrapping brake band and lining. When the band and lining are assembled by usual methods it is found difficult to get close contact between them. In fact the job must be accepted with a permissible gap in spots. To overcome this feature, Oldsmobile built a machine to put brake forming on a production basis. The photograph (Fig. 13) gives some of the detail. The machine has a plate at its center, of the final finished diameter of the band. There is a vertical stud near this plate on which the band is anchored while it is rolled. The rolling is produced by a heavy arm pivoted about the center, carrying three

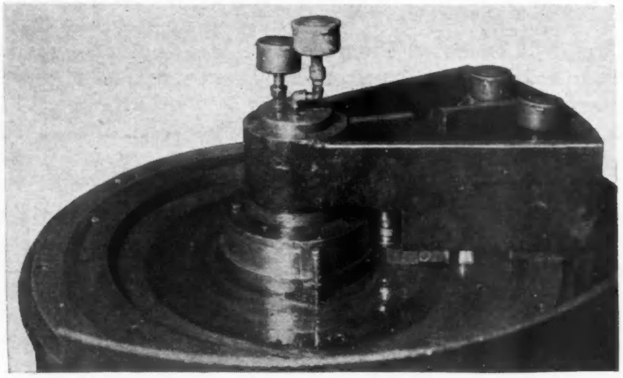


Fig. 13—Installation used to form external brake band and lining

rollers which are forced in against the work by positive pressure regulated by the circular cam at the outer edge of the table.

In preparation for this machine the band and lining are drilled and riveted together while flat. The flat assembly is then set in the fixture. The operator presses a starter button. The arm travels around the band, forms it and comes to a positive stop. The entire operation is fully automatic. The finished product is absolutely true to size and form. Moreover, the lining fits so snugly that a feeler cannot detect separation anywhere.

Output is about 400 pieces per hour.

Adjusting Turning Radius

ADJUSTMENT of stops at the front axle for turning radius control, originally was made when the completed car came off the assembly line at the Pierce-Arrow plant. Now it has been made a production job by a routine operation at the front axle assembly line. To this end the gage shown at the left in Fig. 14 was

Fig. 14—Simple yoke used for adjusting turning radius angle in production line

devised. It consists essentially of a bar with an accurately machined slide fitted with pins at each end for locating in the spring pads. The yoke is a separate piece with a guide at its upper and lower faces to fit the slide. To adjust the turning radius, the bar is set in place on the spring pads. The yoke is brought forward in the slide until it contacts with the brake plate. The stop is adjusted and locked, then the yoke is reversed and the operation repeated at the other wheel.

Drilling and Tapping One Fixture

PLYMOUTH engineers have concentrated considerable effort on a comprehensive scheme of circular indexing fixtures for drilling, reaming and tapping holes in one setting of the working part. This minimizes handling and produces holes which are in correct alignment in all planes.

An example to illustrate the principle is shown in Fig. 16. The operation is to drill and tap a bottoming hole. When loaded the machine works automatically since the movement of the spindles is coordinated with the indexing of the table. The hole is first drilled to a stop, then indexed over to the tapping spindle at the right. Between the two spindles is an air nozzle automatically timed to blow out the chips in the hole as the piece moves by.

This is perhaps the simplest application of the principle in the plant. An extension of this principle solves intricate drilling and tapping operations simultaneously in the horizontal and vertical surfaces. The method shown produces considerable economy in handling, and in final cost. Production 360 pieces per hour.

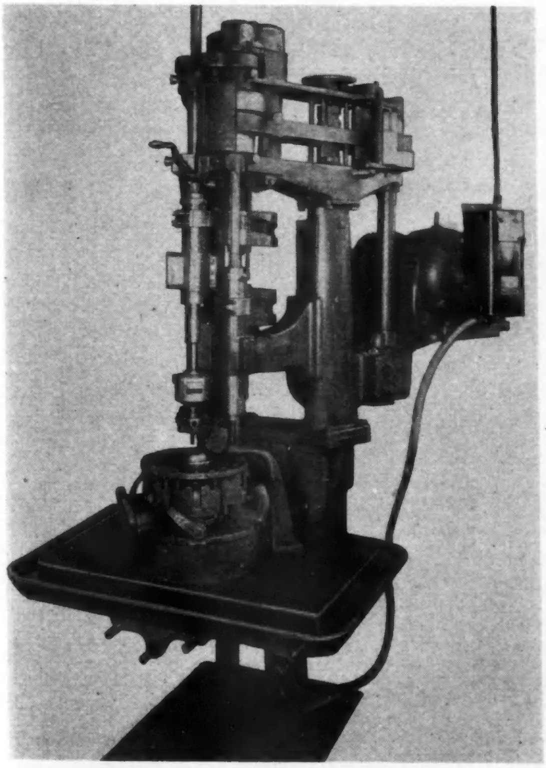


Fig. 16 (above)—Circular indexing fixture for drilling and tapping

Fig. 17 (right)—Drilling brake shoe and band in one unit

Pressing Flange Studs

GRAHAM-PAIGE has introduced a fixture for pressing in crankshaft flange studs which is noteworthy for its time-saving ability and its simplicity of construction.

As shown in Fig. 15, a horizontal bed is used with V blocks to support and align the end bearings. At one end is an air cylinder with a finger which engages the stud head. Nothing more is required except a filler block which fits between the back face of the flange and the head of the machine to prevent distortion of the flange.

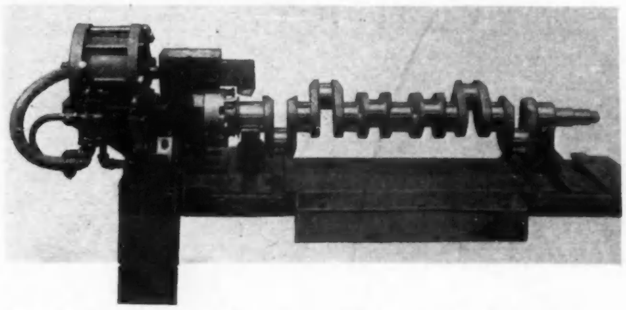


Fig. 15—Fixture for pressing in crankshaft flange studs

The operator places a crankshaft on the bed, pushes in the studs, slips the filler block over the studs, and is ready to work. The air motor is controlled by a foot treadle and at each stroke pushes a stud home. The operator quickly indexes the crankshaft around, working the treadle at the same time.

Brake Band and Shoe Drilling

PLYMOUTH uses a molded brake lining and has found a considerable advantage in drilling the brake shoe and band together.

The machine and fixture are shown in Fig. 17. Note brake shoe and lining in place held under pressure by the lever operated expanding cams. The machine is a familiar type with the important variation that only one hole of each vertical row of two holes is drilled at a time. The driving heads are arranged so that one drills a top hole while the next one drills the lower one of the adjacent row. Consequently the work is indexed twice to completely drill all the holes.

Plymouth finds that brake lining drilled with the shoe while held under pressure gives excellent results at assembly and helps make a substantial saving by eliminating extra handling of the lining.

Production Line Process for Plating Attained Within the Past Year

Problems in deposition of chromium have led to improvement and standardization of polishing and allied operations which have replaced former haphazard and uncertain methods.

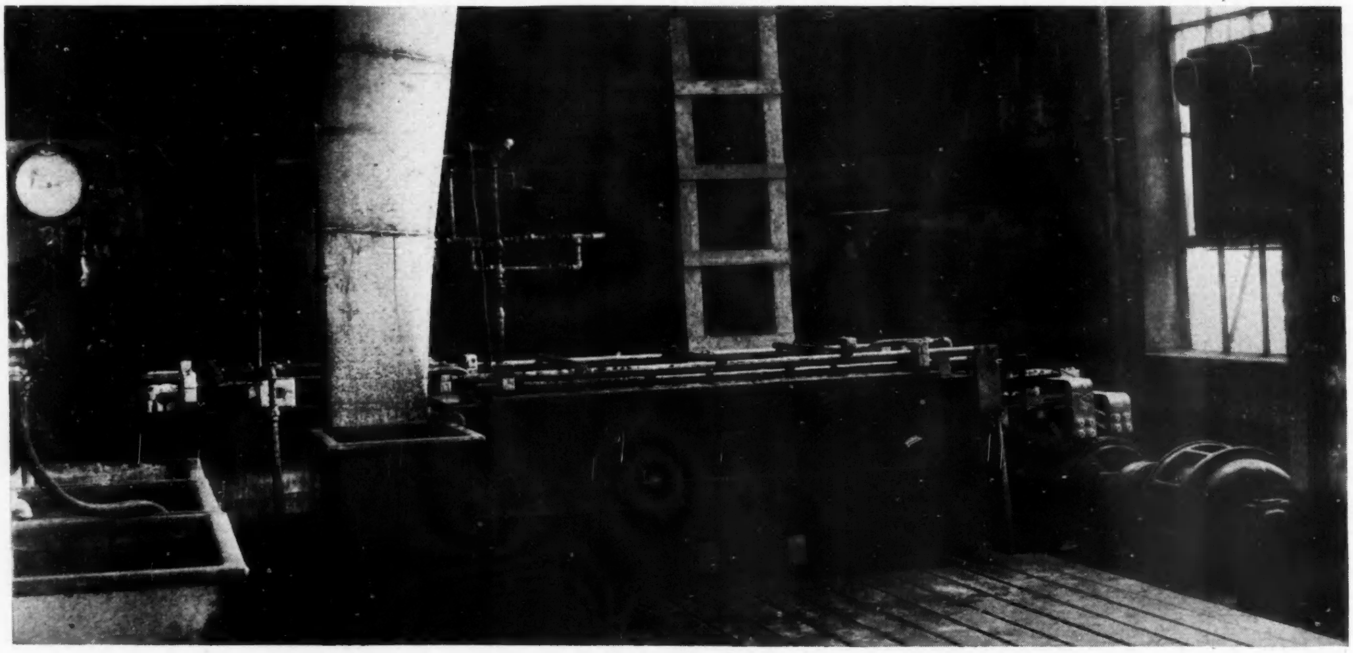
By EDMUND B. NEIL

PROBABLY the most important development in chromium plating methods occurring within the past year or so is that the whole plating process now has been raised to what may be termed a "production process." This in turn implies that in place of the more or less haphazard methods previously associated with all forms of plating, the knowledge, precision and control requisite to certainty of result in other processes of automotive manufacture have been applied to electroplating as a whole, and to chromium plating in particular. Second in importance is the more general application of chromium plating for wear resistance or the prevention of corrosion, as well as for beauty of finish.

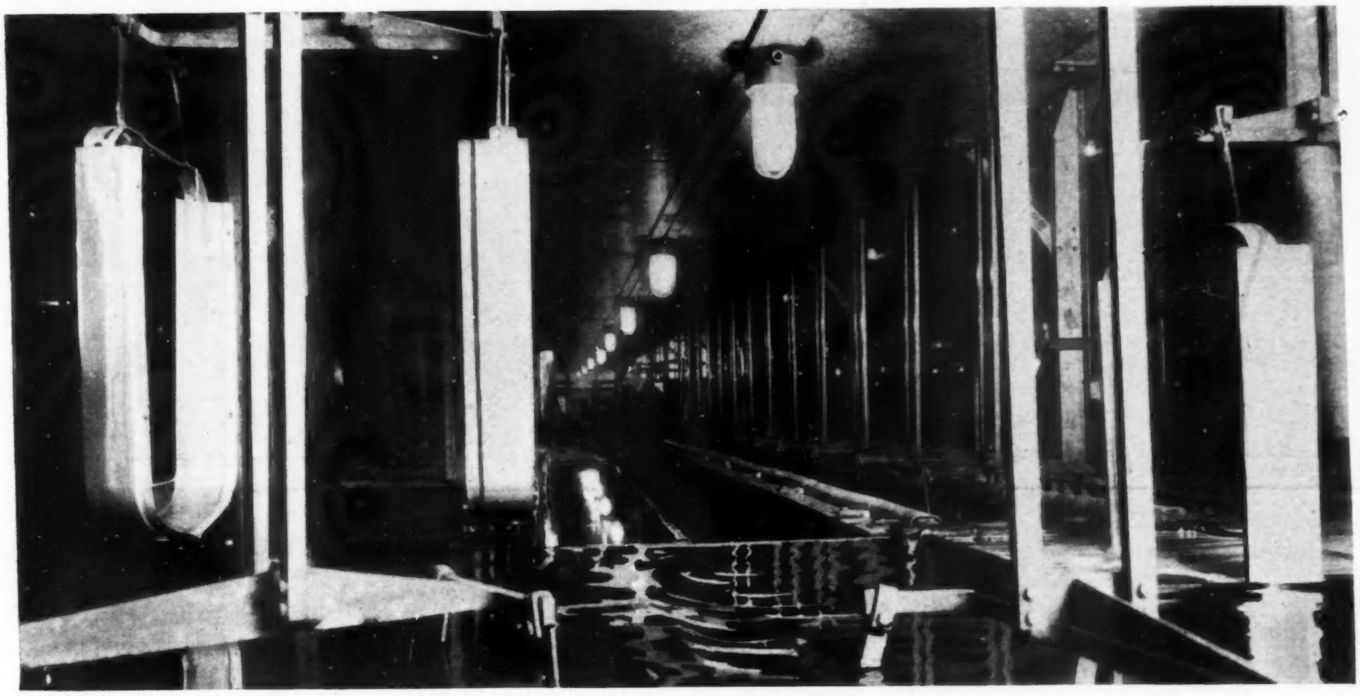
The placing of chrome plating in the "production line" and its acceptance as an essential part of routine manufacture, while naturally presuming that many of the problems incident to it have been solved, by no means can imply that they all have been overcome; for on the one hand, we have those who feel that the process requires but general supervision and is quite simple, and on the other those who have found it possible to produce satisfactory results only after much experiment and many failures. It seems reasonable to assume that the more exact the knowledge and experience that can be applied and the better the chemistry and physical behavior of the process is understood, the more rapid future progress will be and the sooner the applications of chromium plating now in the experimental stage will become regular and accepted practice.

That satisfactory chromium plating for tarnish resistance, beauty and wear resistance depends upon striking a proper balance between the variables influencing the process is now an accepted fact. The nature and number of these variables may be taken as one of the reasons why the process has run into trouble in the past, and, also, why it is more difficult to apply in general or job plating work than where it is used under more readily controlled conditions.

Of these variables the most important are, (1) the composition of the solution, which in turn involves two factors, chromic acid concentration and sulphate ratio, (2) the current density, and (3) the temperature. Sub-



Still tank chromium plating unit showing generator, and control panel at the right, with plating tank in the center and rinse tanks and temperature control at the left (Hanson-Van Winkle-Munning Co.)



Full automatic plating conveyor for chromium plating radiator shells
The glazed surface in the foreground is the cold water rinse tank on the end of the conveyor where the shells make the turn to go on to the next assembly step.

sidiary only to these is (4) proper handling of the work, which involves the use of racks, anodes, agitation of the bath, and finally, ventilation, which is certainly important from the standpoint of health where there are certain dangers if precautions are not taken.

Chromium is usually plated from chromic acid solutions ranging in concentration from 200 to 500 grams per liter (27 to 67 oz. per gal.). Solutions containing chromic acid alone, however, do not produce useful deposits. The usual addition agents are sulphuric acid or one of the common sulphates (sodium sulphate). Other additions may be employed with equally good results, but sulphate solutions are the ones commonly made in many chrome-plating plants. Sulphates are found in all technical chromic acid. The proportion of sulphate to chromic acid seems to be a factor of fundamental importance and numerous studies have established the best value of this ratio at around 100 to 1. The ratio does not seem to be greatly influenced by the concentration of the chromic acid or by the temperature.

While the value of the use of certain addition agents other than the sulphates is open to question, the presence of some substances is admittedly deleterious and has proved to be the cause of failure. Among these are tri-valent chromium and iron, the former being formed to some extent by reduction at the cathode, and may accumulate rapidly with certain types of anodes, especially steel or chromium. The effect of tri-valent chromium in small quantities is not so much on the current efficiency as it is on the range of current densities within which bright deposits are obtainable. Possibly this effect is associated with the increased resistance caused by the accumulation of tri-valent chromium in the solution. Iron behaves in much the same way. In larger percentages both iron and tri-valent chromium lower the current efficiency and prevent successful plating.

The second and third factors to be controlled are current density and temperature. The use of low current densities such as are commonly employed in nickel plating results only in reducing the chromic acid at the cathode with the formation of tri-valent chromium. The appearance of a brownish color due to the inclusion of oxide in the deposit is also the result of too low a current density. With a higher current density the evolution of hydrogen takes place (gassing), and a bright deposit of chromium begins to appear. The yield of chromium, i.e., the current efficiency, increases as the current density is increased, but, except where the appearance of the surface is not a factor, there is a limit that may be realized from this, since the deposit does not retain its bright character, but becomes matte or gray at the higher current densities. The term "plating range" is usually applied to the range of current densities within which bright deposits are secured. It is closely related to that "bogey" of chromium plating—"throwing power."

Decreasing the temperature raises the current efficiency but narrows the plating range and lowers the conductivity of the solution. On the whole, therefore, lowering the temperature lowers the throwing power, and the only gain is a small increase in current efficiency. It is not surprising then to find that most chromium plating now is carried on at temperatures where bright plate can be obtained, even with some sacrifice of current efficiency. The usual range for decorative plating is fairly narrow, being seldom as low as 90 deg. Fahr. or as high as 120 deg. Fahr. Since labor for polishing is more expensive than power for plating, this practice would seem to represent a sound business view of the alternatives. Fig. I illustrates the ranges of current density, and temperature within which satisfactory and unsatisfactory plating is obtained.

Obtaining bright plate is the prime requisite of most chrome plating done at the present time, although, as previously mentioned, plating for wear resistance where the brightness of the deposit is a minor factor is coming into more general use. To polish hard gray plate is prohibitive in cost. The only practical method, and the one now generally followed or aimed for, is to polish the undercoating or base metal to produce the desired finish,

and then to deposit bright chromium. It is safe to say that the advent and present status of the art of chrome plating has resulted in as much improvement in polishing practice as it has recently improved nickel plating methods, through recognition of the necessity for close control of plating condition.

While chrome plating without temperature control may be justified in those cases where the metal is deposited for wear resistance only, and where appearance is not important, it seems fair to say that it is largely through this and other control methods that chrome plating has made the progress as a production process that it has during the past year or so. In most plants intermediate temperatures are employed. The difference between the current efficiencies so obtained as compared with those in the lower temperature range is but a few per cent in actual practice. Since a change of a few degrees in temperature may result in spoiled work, the use of automatic temperature control has become accepted practice in many large plants. The voltmeter, ammeter or current density meter are also accepted instruments in best commercial practice.

Of the two ways to improve current distribution, namely, shaping the anodes and correct design of the supporting racks, the latter seems to offer the best means, the resort to special anodes being acceptable only where rack design cannot solve the problem. At the same time it can be shown that racks are often the only means by which satisfactory results may be obtained.

General principles of correct rack design have been developed from practical experience. The first consideration is to equalize the resistance for various current paths so as to deliver sufficient current to every part of the piece, and to rob those parts which might otherwise receive too much. Contacts must be large enough

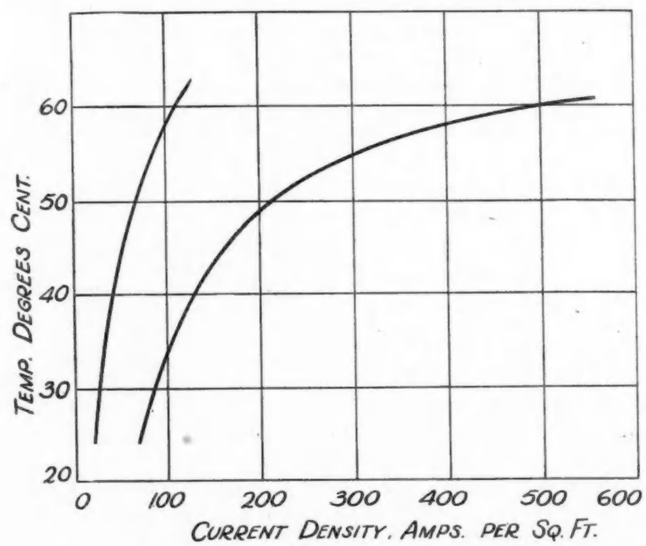
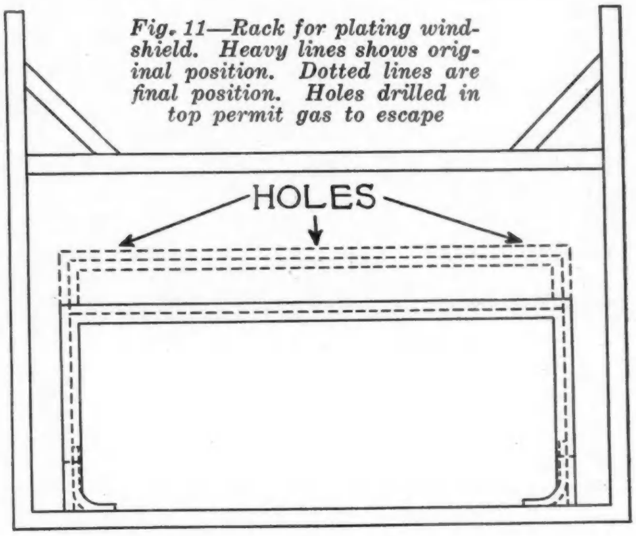


Fig. 1—Ranges of current density and temperature for plating

to carry the current without overheating. Excessive current densities at contacts may result in "contact marks." The position of the work on the rack must be such as to avoid air or gas pockets. Good racks must not only solve the plating problem, but must be simple in design and easy to load, handle and unload. A great advance in their design has been made, but there is still room for a high order of production engineering in this field alone. Fig. II shows how, by simple inversion of the piece—a windshield frame—"burned" parts were avoided.

Under normal manufacturing conditions, by which is meant control of composition, its recognition by the manufacturer as a chemical process amenable to laboratory control and to operation by experienced men, the cost of chrome plating, contrary to lay opinion (and in many instances the amounts charged for it), should be but little, if any more, over a period of time than the cost of plating nickel in still tanks, or in automatic tanks where comparable operations are performed. On comparing the metal costs alone, chromium is found to be slightly cheaper, while from the standpoint of power cost, nickel is ahead. The labor cost, which in the final analysis is the principal one, is the same.

Fig. 11—Rack for plating windshield. Heavy lines shows original position. Dotted lines are final position. Holes drilled in top permit gas to escape



There is, of course, a considerable difference in the cost of equipment for chrome plating and for nickel, due to the larger generators required to produce power for the former. Another item of investment cost is a suitable ventilating system, one which will not only keep the chromic acid spray down close to the solution, but which will separate it from the air current and properly dispose of it also.

Examples of 1929 Chrome Plating Practice

1. Several car makers now using chrome-plated parts for wear resistance—piston pins, king bolts, anchor bolts in front axle brake linkages, etc.
2. Worn plug gages plated and reground to size as a salvage operation. These last six times as long as unplated new gages.
3. Use of copper flash on gages on end originally sized to low limit and afterward chrome plated and ground to high limit to indicate that gage had worn. Appearance of copper color on gage indicates wear to low limit size.
4. Sewing machine needles in trim shop of large producer of cars wore out in one day's operation. New ones chrome plated last 10 days.
5. An inspection fixture used for checking ring grooves in pistons found to last indefinitely after chrome plating, whereas frequent replacement was formerly required.
6. The use of ordinary tracing cloth in front of powerful lamps serves as an excellent means of detecting flaws in chrome plated surfaces.
7. Life of forming dies increased up to eight times, stamping dies up to three times, hot forging and drawing dies up to several times when thinly chrome plated. Molding dies for phenolic resins materially improved.

Apprenticeship in *Tool Designing* *Deemed Necessary* for Executives

Training in actual shop practice, including not only time study and rate setting, but actual work at the tool-cribs and cutter grind, deemed vital to engineer.

By GEORGE W. BLACKINTON*

THE need of tool designing today is more technically trained men who have had preliminary experience in their particular industry, possibly spending some time in the engineering department, and some time in the shop before they tackle tool engineering work. On entering tool engineering as a specific profession, they should be required to spend some part of their apprenticeship in time study and rate setting, and part of it actually working on the board designing tools, before assuming a responsible position as a tool designing executive.

A proper course of training along this line, in combination with a general technical background, should fit a man to become a valuable executive in tool designing. Further good might be accomplished if the prospective executive were to spend some time in the tool-cribs and cutter grind during his preliminary work. Such experience should improve his analytical powers, and enable him afterward, when necessary, to go down in the shop and do some real constructive thinking on the practical side of tool designing problems.

Time spent in watching actual operations and carefully analyzing them in detail, particularly with regard to the wasted physical effort expended by the machine operator, would soon make apparent to the prospective designer the enormous quantity of energy in foot pounds expended in the average operation. He would see, for instance, in many cases where chain fall is being used, with a consequent expenditure of physical labor for the loading and unloading of heavy pieces in and out of machines, the possibility of a tool-up which would save a large proportion of the physical effort formerly necessary.

Take an extreme case in the production of a heavy automobile crankshaft, for example. There is an enormous amount of physical effort consumed every day in lifting crankshafts into lathes and grinders, and then lifting them out again. Most of this could be eliminated if the machine were so constructed that the operator had to use no more physical energy in loading and unloading the crankshaft than he would in performing the same service for a piston.

The average tool-designer is more or less of a parrot. He has grown up in the tool designing department of his plant from his earliest efforts on a drafting board, without the particular mental training which would fit him to assume an executive job, and, in many cases, without a great deal of practical shop experience. The result is that when a model is changed, and there is a new part to be tooled-up involving slightly different shapes and sizes, he simply goes to the files and gets out drawings or tracings of tools previously designed for a similar part, and makes the necessary changes in dimensions, clearances, etc. It is very seldom that he brings anything new to the problem, unless it is obtained by rule of thumb methods, following the inspection of a better system in use in another plant.

It is believed that a course of apprenticeship along the lines already indicated would do a great deal in stimulating tool design executives to an appreciation of the necessity of constantly maintaining an analytical attitude toward the problem of reducing the expenditure of human effort to a minimum. This is the legitimate concern of the tool designing department of any production industry, and will make for much higher efficiency in the large production job. A great deal has already been accomplished along these lines by bringing the matter to the attention of machine tool builders and tool designers, but there is still a great deal to be accomplished, and it seems to be squarely up to the tool designing department of a particular industry to get it done.

George W. Blackinton

Ed. Note—Mr. Blackinton was formerly factory manager of Continental Motors. He is now associated with the Sullivan Machinery Co., Chicago.

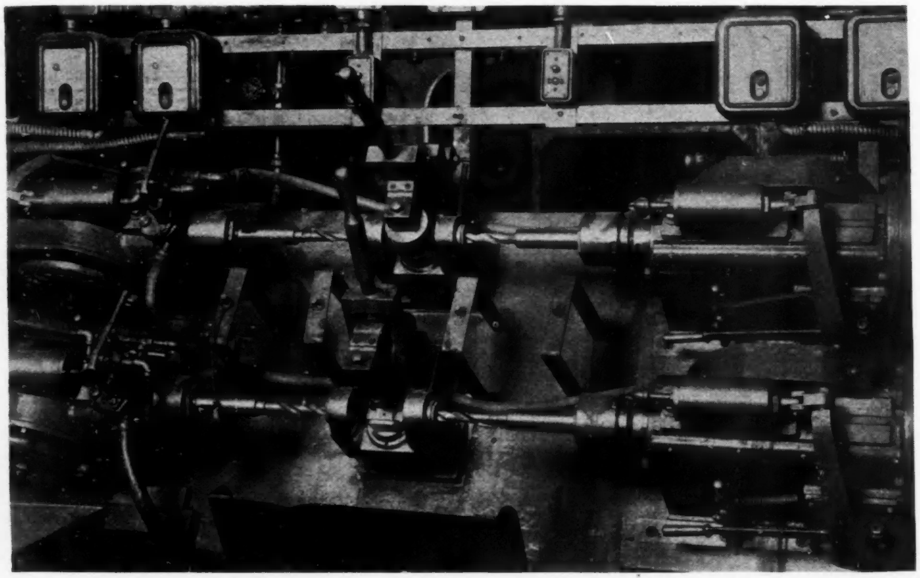
Survey of Machining Practice for Indicates a Wide Divergence

Considerable variation in major companies, while the actual processes differ with

By ATHEL F.

DIFFERENCES in the machining of unslotted pistons center themselves chiefly in the method of locating during the machining cycle. For purposes of study, five such pistons have been selected. All but one of these are cast iron, that of Continental Motors typifies the production line on which flexibility of a high order is required. The LaSalle piston has been selected as representative of the higher priced class of cars, which are offered to the consumer for fairly high speed initial operation without breaking in. The Oldsmobile six-cylinder piston is studied in relation to fairly high quantity production.

The Reo piston also has been added to this group, although it is composed of an aluminum alloy, because its general design and machining problems are similar to those of cast iron pistons. To the list has also been added the Viking piston, to show that even in the machining of almost identical types of pistons by the same company, differences are found in the line-up of machining operations.



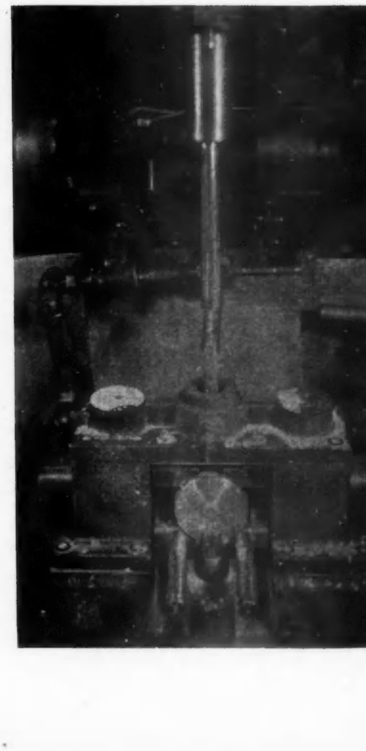
There is considerable diversity in the methods used in boring the pin hole, as the accompanying five photographs show. Above is the Oldsmobile set-up (cast-iron piston), with opposed feed heads and quick-acting piston clamps interconnected with the feed-starting air-pressure line

For the purpose of comparison of machining practice, the following major operations have to be considered:

1. Machining the primary locating surfaces or centers.
2. Machining the secondary locating surfaces or centers.
3. Machining and grinding the OD.
4. Turning lands.
5. Cutting ring grooves.
6. Facing the head.
7. Machining the pin hole.
8. Cutting the skirt to length.
9. Machining the lockscrew hole or retainer ring groove.
10. Cutting the skirt relief in the pin hole.
11. Machining to weight or selecting in sets by weight.

Table I indicates some of the differences involved in these major operations. Considerable difference is noted at once in the primary locating. Continental and Oldsmobile use two operations for boring and reaming the skirt and centering the head. LaSalle cuts a skirt center only, and that after roughing the OD, and centers the head together with the finish OD turning and grooving, before grinding. Reo centers both head and skirt in the first operation.

In the secondary locating points, there is an even wider



Dodge Brothers eliminates two pin hole operations through the use of this gun drill set-up (right) on a single-spindle drill press. Note the method of locating the piston

Both Slotted and Unslotted Pistons
of *Methods Among Manufacturers*

operations is evident among turning, cutting and grinding the type of unit used.

DENHAM

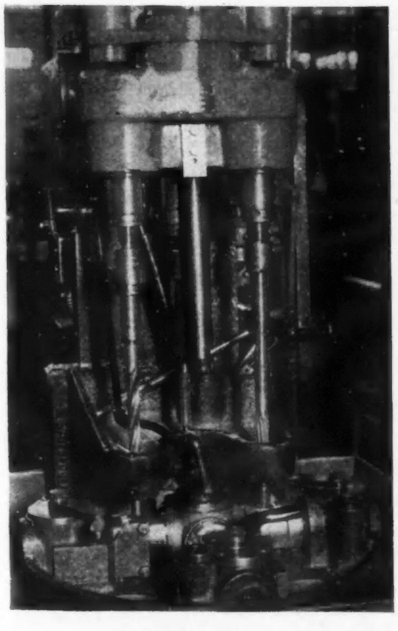
divergence. Continental, Olds and Viking use the skirt bore and face all the way through for locating, including the pin hole machining. LaSalle corrects the counterbore to the pin hole. Reo, on the other hand, uses the head face for the secondary locating, including pin hole machining.

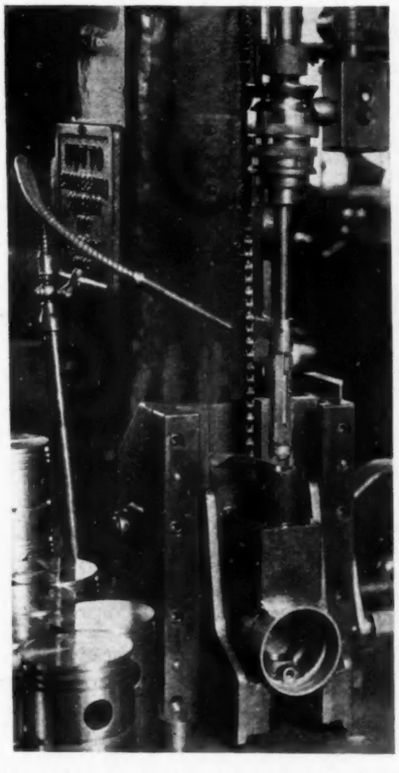
Turning of the OD is generally performed in two operations. In the cast iron pistons, rough turning is with Stellite on the Olds, Viking and Continental. LaSalle, however, uses tungsten carbide hogging tools, performing this operation before the annealing of the piston, in contrast with the other manufacturers. Reo uses tungsten carbide tools all the way through in its machining, its aluminum alloy piston, of course, requiring no annealing. Finish turning of the OD on the cast iron piston is generally performed after rough drilling the pin hole, even with pistons in which the secondary locating is not referred to the pin hole itself.

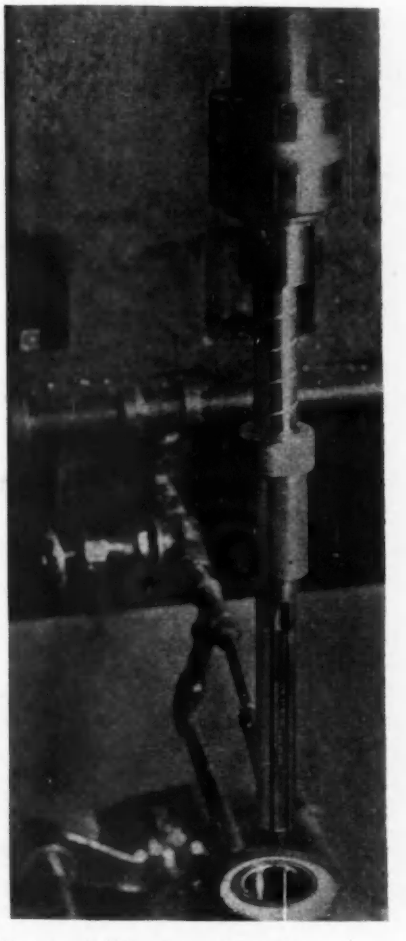
In grinding OD of pistons, Continental and LaSalle use arbor type grinders all the way through. Oldsmobile and Viking pistons, on the other hand, are both rough and finish ground on centerless grinders, while Reo grinds first between centers and then on a centerless.

Machining ring grooves is generally performed in two operations, but Olds, Reo and Viking combine rough and finish grooving with rough and finish OD turning, while Continental has a separate operation for grooving alone, combining rough and finish grooving on the same machine, and LaSalle does its rough and finish grooving in one set-up together with the single finish turning which follows annealing. LaSalle's extra grooving operation consists in burnishing the ring grooves on a lathe.

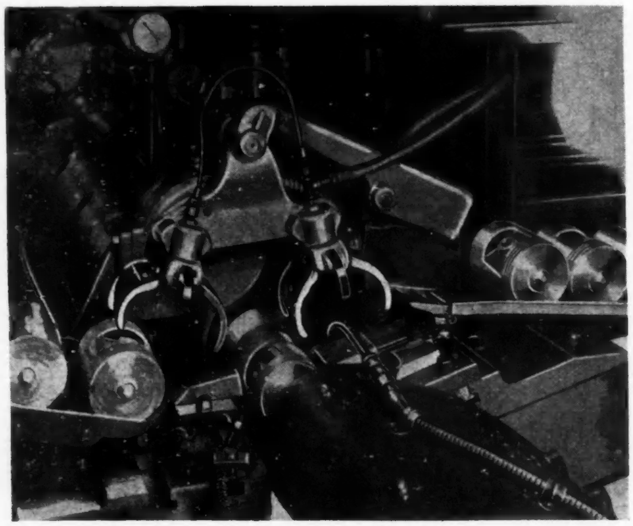
Three operations on the piston head, also, are performed by LaSalle, consisting of rough turning, removing the centering boss and finish grinding. Removal of the centering boss is eliminated by Oldsmobile, Continental and Viking through counterboring the head when it is initially centered. The rough facing, therefore, can be carried up to the center hole and still leave a center in the head. Reo achieves the same end by not requiring the use



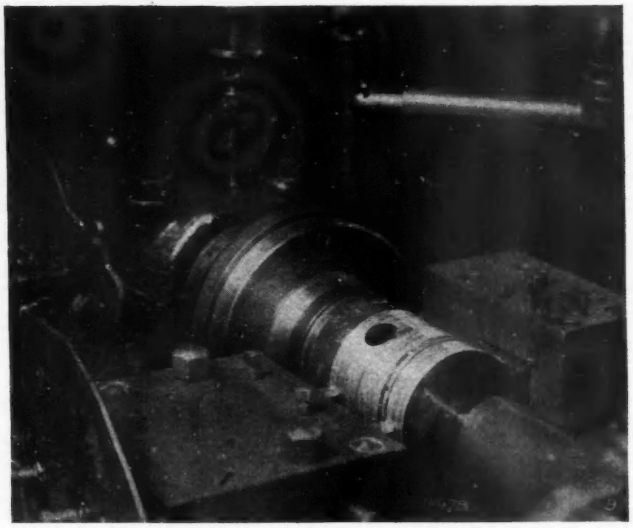




Graham-Paige saves considerable time in the boring of its pin holes by combining drilling, rough and semi-finish reaming on a three-spindle Barnes drill with indexing table (left). Cadillac finishes its pin holes by honing (center). Reo uses a boring bar, with inserted carboloy tool for its rough boring. Note the large pilot used (right)



More generally than not, ring turning is combined with OD machining. At the left is the automatic loading and unloading Lo-Swing lathe used for this purpose. Below is the set-up used by Reo, using carboloy-tipped tools



of a head center for locating after the finish facing. Olds and Viking finish the head by surface grinding, while Reo and Continental do this on a lathe, locating from the OD and pin hole.

Operations on the pin hole diameter range from four to six as will be noted. While Continental has six boring or reaming operations, however, it has only four "set-ups," one of these combining finish drilling and reaming on a turret lathe, and the second consisting of line reaming and burnishing on bench burring heads without locating, using piloted tools. The second is also true for Olds and Viking, while LaSalle eliminates one "set-up" by finish boring and rough reaming in one set-up on a turret lathe. Reo finishes the pin hole by diamond boring, thus eliminating the line reaming operation. Its rough boring and reaming is performed on a two-spindle drill press, the fourth operation being counterboring of both ends of the pin hole on a hand feed drill. Incidentally, Reo reserves the rough boring operation until after semi-finish grinding, since it desires to use the OD for locating in boring the pin hole to obtain squareness. The finish sizing of the pin hole by honing in the LaSalle line is also of particular interest.

Skirt reliefs, when used, are generally cam ground on an arbor between centers. Since accurate matching by weight is important with cast iron pistons, they either have to be selected in sets or else machined to exact weight. The latter method is used by LaSalle and Viking and the former by the other companies.

Cutting steels used on these pistons range from high speed to the new tungsten carbides. Continental uses Stellite for hogging the casting and also machining the ring grooves. So do Olds and Viking with the addition of the finish head facing tool. LaSalle's use of tungsten carbide for rough turning the OD has been referred to. Reo uses carboloy for all major operations except grinding, rough reaming and diamond boring. Following are outlines of the machining practices in the various plants studied:

Cadillac Motor Car Co.

Several unusual operations are found in the LaSalle semi-steel piston machining line. These include an annealing after rough turning the OD, burnishing the ring grooves with rollers under pressure, and the use of hones for final sizing of the pinhole. In general, after the annealing to relieve strains the skirt is counterbored and chamfered to provide a locating point for rough drilling the pin hole and finish turning OD, the grooves and facing and centering the head. The open end center is then rechamfered and the piston is rough ground between centers, these two operations are repeated and the ring grooves are burnished. Next, the pin hole is semi-finished, furnishing its own location, and lands and OD are finished ground between centers. Using pot chucks, the head is finished ground, the skirt counterbored to weight and the pin hole finished.

In sequence the LaSalle operations are as follows:

1. Rough turn OD on lathe with expanding internal chuck, using tungsten carbide tools.
2. Heat treat to relieve strains.
3. Counterbore and chamfer open end on a lathe, chucking internally.
4. Rough drill pin hole on double-ended lathe with opposed feed, locating from open end, and milling inside of wristpin bosses at the same time with special fixture.
5. Finish turn OD, rough and finish turn ring grooves, face and center head on semi-automatic turret lathe, locating from the open end fore and pin hole.
6. Remove scale from skirt bore on drill press locating from OD and head.
7. Correct open end center.
8. Rough grind OD, removing 10 to 12 thousandths (.010 to .012) on arbor.
9. Drill smoke holes on double-end high-speed lathe with opposed feed and ratchet index for the piston.
10. Rechamfer open end and regrind on arbor, removing .005 in., leaving .0015 for finish grinding.
11. Burnish ring grooves with rollers on lathe between centers.
12. Finish bore and semi-finish ream pin hole on turret lathe, leaving .004 in. for finishing. Location is by fixed pin plug in turret, with piston locked externally.
13. Machine lock screw hole on multiple-spindle hand-feed drill press.
14. Finish grind between centers. In this operation selective fitting by sizes is accomplished by grinding to one of four sizes differing by .0005 in.
15. Burr wristpin hole and taper grind lands between center.
16. Remove head end centering boss.
17. Grind head on Miller type grinder with reciprocating and rotary feed for the piston. Locating for height is by a pin hole plug with the piston in a pot chuck.
18. Wash.
19. Burr piston on high-speed bench lathe with emery cloth and file.
20. Bore out skirt to weight within plus or minus ⅛ oz. on special miller. The piston is held in a pot chuck on a

rotating spindle with cross feed for the tool. The latter is hand-operated and provided with vernier graduations on the hand wheel to correspond with scale reading.

21. Line ream pin hole to .0005 in. on bench fixture. Piston held in pot chuck, reamer is piloted and air is blown onto the reamer through the open end of the piston to clean out chips.

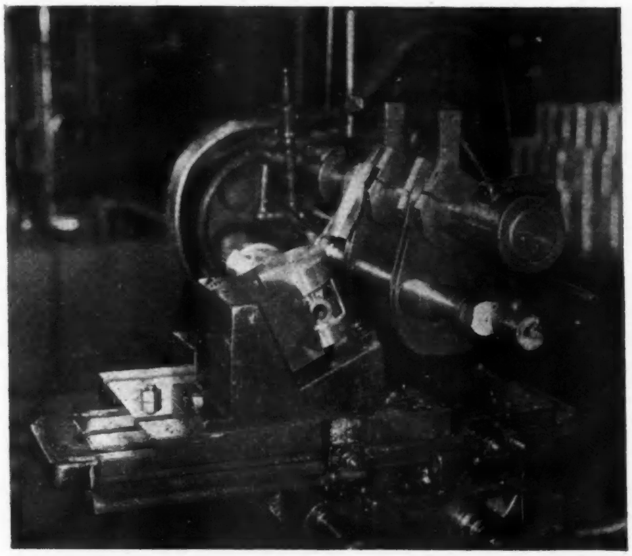
22. Hone pin holes on four-spindle special lapper, locating from the OD.

23. Wash and inspect.

Reo Motor Car Co.

The piston used by Reo while of aluminum alloy and, therefore, lighter in weight than cast iron, approaches the latter more nearly in its design and general characteristics. The alloy is noted for its low expansion permitting close fitting without provisions of expansion slots or separation of the skirt from the head. Due to its toughness it cannot be easily machined with high speed steel, and Reo uses carboloy in all operations except grinding and diamond boring.

In general, both ends are first centered for rough turning, grooving and facing the head. The open end center is then corrected to the head face for finish turning OD and grooves between centers as well as rough OD and finish land grinding. The OD is next semi-finish ground to size so that the OD and head face can be used for locating in the pin hole machining operations. Finish grinding, the last operation, is also centerless. Freer cutting grinding wheels than usual are used.



An efficient set-up for sawing slots is this single-arbor, two-cutter, two-fixture miller used by Graham-Paige. It cuts the sawing time materially and eliminates one machine tool. Note the guards over the saw blades

In sequence the Reo operations are as follows:

1. Center head end, face open and chamfer on Mulholland lathe with expanding chuck.

2. Rough turn and groove and finish oil groove recess on LeBlond lathe between centers.

3. Drill two holes from oil groove into pin hole on single-spindle hand-feed Avey with barrel chuck.

4. Drill smoke holes on single-spindle Avey with barrel chuck. Piston indexed by hand, but chuck is provided with a ratchet stop for correct spacing.

5. Rough face head on Milwaukee lathe between centers. Skirt center is spring-mounted so that alignment is by skirt face.

6. Finish bore and countersink open end on LeBlond lathe, with piston held in external air chuck, locating from head face for squareness.

7. Finish turn OD and grooves on LeBlond lathe between centers.

8. Rough grind OD on Landis grinder between centers, removing .007 to .012 in.

9. Semi-finish grind for size on Cincinnati centerless with through feed. .005 in. is removed here.

10. Taper grind head face on Landis grinder between centers.

11. Rough bore and ream pin hole on two-spindle Leland-Gifford drill press, locating from top of head and OD with V block for wrist pin bosses, trunnion mounted for locking the piston. Rough boring is by piloted boring bar with carboloy inset. The reamer, which is stellited, removes .045 in.

12. Counterbore both ends of pin hole on hand-feed H. & W. drill press.

13. Burr both ends of piston by hand file.

14. Finish face head on LeBlond turret lathe, locating from pin hole with piston clamp in external air chuck.

15. Burr grooves on speed lathe with file.

16. Finish diamond bore pin hole on Coulter two-spindle automatic. The piston is pushed into a barrel head first, is located for depth and position by a pin hole plug from the bottom and is clamped against left-hand side of the OD with a swivel clamp. The latter is also connected to an automatic ejector to facilitate unloading, operating on the head end. In this operation .012 in. is removed.

17. Wash.

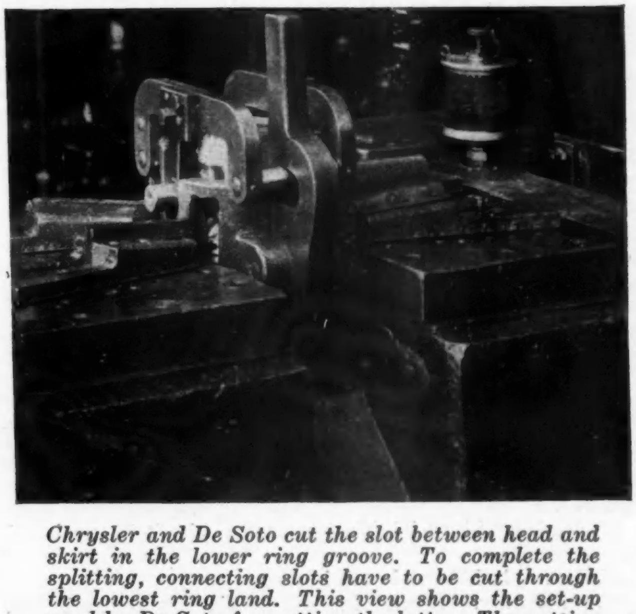
18. Finish grind OD on Cincinnati centerless, equipped with kickback for piston so that one operator loads and unloads from the same side.

19. Wash and cool piston.

20. Inspect and select for weight.

Olds Motor Works

In machining Oldsmobile and Viking cast iron pistons, all locating is with reference to the counterbore, including all pin hole machining, thus obviating any necessity for correcting either face or the OD to the pinhole for squareness. Stellite tools are used for rough and finish turning the OD, grooves and head. Features of the machining line include counterboring the head when centering so that the piston will not have to be re-centered or a centering boss left after rough facing. An interesting pin hole finish boring set-up is also used for accurate line reaming of the pin hole, square with the OD. The use of a surface grinder with magnetic



Chrysler and De Soto cut the slot between head and skirt in the lower ring groove. To complete the splitting, connecting slots have to be cut through the lowest ring land. This view shows the set-up used by De Soto for cutting the latter. The cutting tools reciprocate, and the piston mounting spindle has an automatic vertical feed upward

TABLE I

(Unslotted Pistons)

		Continental	La Salle	Oldsmobile	Reo	Viking Z
1.	Primary location	Centers	Counterbore	Centers	Centers	Centers
2.	Secondary location	Skirt bore	Pinhole	Skirt bore	Head face	Skirt bore
3.	OD No. of operations	4	5	5	5	4
	Includes grinds	2	3	3	3	2
	On centers?	Yes	Yes	No	Yes and No	No
4.	Land finishing	With OD	Separate	With OD	Separate	With OD
5.	Groove with	Separate	OD & Separate	OD	OD	OD
	No. of cuts	2	3	2	2	2
6.	Head, cuts	2	3	2	2	2
7.	Pin hole, cuts	6	5	5	4	5
	Set ups	4	4	4	3	4
	Finish by	Line ream and burnish	Line ream and hone	Ream	Diamond bore	Line ream
8.	Pin lock	Ring	Screw	Screw	None	Screw
9.	Skirt relief	Grind	None	Grind	None	Grind
10.	Weight by	Select	Boring	Select	Select	Boring

The above table for low expansion pistons having no expansion slots, or slots between head and skirt, summarizes some of the major differences in piston machining practice among the companies investigated.

chuck and continuous feed for finishing the head is also a departure from conventional practice, made possible by locating everything to the skirt center and face.

Operations in sequence follow for both Oldsmobile and Viking unless otherwise noted.

1. Face and bore open end and counterbore and center closed end on lathe with expanding air chuck.
2. Ream open end to size on single-spindle drill with hand feed, with the piston held in a spring-mounted ring.
3. Rough turn OD, grooves and rough face head on semi-automatic lathe between centers. The head end center is so designed that the head can be faced to the centering counterbore without leaving a boss.
4. Rough drill pin hole on special fixture with two electric opposed feed heads. Locating of the piston is from the skirt end with a clamp on top of the head. The latter is connected to the air line which starts the feed. Both drills are piloted in the fixture. These tools are mounted in pairs so that the operator can unload one piston while the other is being drilled.
5. Finish turn OD, face head and groove on lathes locating between centers.
6. Drill smoke holes. On the Oldsmobile this is performed on a radial drill with 10 electric drill heads. On the Viking a two-head centering machine with opposed feed and ratchet index for the piston is used.
7. Finish bore pin hole on horizontal cross bore multiple-spindle machines using an inserted blade in a piloted boring bar. Locating is by means of the pilot, with the piston held by a skirt clamp.
8. Machine lock screw hole on three-spindle drill press in three operations.
9. Olds only. Chamfer inside hole in pin boss.
10. Grind head face on surface grinder having a magnetic chuck for three-quarters of its circumference and continuous feed. In this operation .010 to 0.12 in. is removed.
11. Rough grind OD on centerless grinder with through feed work rest and automatic profiling attachment. .008 in. removed.
12. Olds only. Grind skirt relief on arbor grinder with eccentric cam on the arbor spindle.
13. Semi-finish line ream pin hole on bench burring head with piston located by the reamer pilot and locked in the fixture by an air-operated skirt chuck. .003-.004 in. removed.
14. Viking only. Finish line ream pin hole on bench burrer.
15. Burr pin hole on bench burrer.
16. Olds only. Ream pin hole to size on bench burrer with eight-flute solid pilot reamer, removing .001-.005 in.
17. Wash and clean.
18. Olds only. Semi-finish grind on centerless grinder with through feed and automatic profiling attachments.
19. Finish grind on OD on centerless grinder with automatic profiling attachment and through feed.
20. Wash, blow out and wipe.
21. Viking only. Hollow mill inside of skirt bore to weight on four-spindle drill press with spindle graduated.
22. Inspect.
23. Olds only. Select in sets to weight.

Continental Motors Corp.

Due to the fact that several different sizes of pistons have to be run over the same line, its keynote is flexibility. In general the open end is first finished, bored and faced and the head centered. Using this location, the pinhole and OD are roughed out and the latter is finish turned and rough ground. Locating from the rough bored pinhole, the pinhole is next semi-finished. Going back to the centers, ring grooves are cut, smoke holes, etc., are drilled and the skirt relief ground. Using the OD to locate again, the head is finish faced to length above the pinhole, with finish grinding between centers and finishing the pinhole without location following.

In sequence the operations are as follows:

1. Rough bore and face open end on an Acme lathe, with external three-point check for OD.
2. Finish bore and face the open end and center closed end on a B. & O. lathe, with an expanding air chuck.
3. Rough drill pin hole. Eight-spindle vertical Moline drills, the spindles being in pairs, an upper and a lower with opposed feed. Locating is from the open end with a clamp on the head and spring V-block center against the pin boss. Each eight-spindle drill is handled by one operator.
4. Rough turn OD and face closed end on a Sundstrand stub lathe between centers.
5. Chamfer open end on hand-feed Cincinnati drill with locating pin for head center.
6. Finish turn OD on LeBlond lathe between centers.
7. Rough grind on Norton grinder between centers.
8. Finish drill, ream and cut retainer ring groove in pin hole on a B. & O. turret lathe. Piston is centered by a pin hole plug fixed in the turret, and is clamped in a barrel chuck attached to the drive spindle. The retainer ring groove on both sides is cut with a single boring bar having two tools mounted on it, with cross feed for the turret.
9. Rough ream pinholes on bench burrer.
10. Rough and finish cut ring grooves on a Rapid Product lathe between centers.
11. Drill smoke holes in lower ring groove on a hand-feed drill press with piston resting in a V-block provided

with a guide for the lower ring groove. Indexing is done by hand.

12. Countersink pin holes, drill oil holes in pin boss, etc., on hand-feed drills.

13. Grind skirt relief on Norton grinder between centers with eccentric cam action for the arbor spindle.

14. Finish face head on a LeBlond lathe. Split barrel chuck for OD with pin hole locating plug in one-half.

15. Re chamfer open end on hand-feed drills without locating.

16. Finish grind OD on Norton grinder between centers.

17. Wash and finish ream and burnish pin holes on bench burring heads with piloted tools.

18. Inspect and select according to weight.

Slotted Pistons

Passing on to the slotted aluminum alloy pistons, including both strutted and unstrutted types, an even wider divergence in machining practice is found. To the differences in locating found in the machining practice on cast iron pistons, have to be added further differences of opinion on the proper place in the line to machine the slots,

First, in consideration of their effect on the ability to machine accurately between centers, and

Second, since by relieving internal strains they are generally said to necessitate subsequent corrective machining of the surfaces affected.

In studying the machining practice eight types of pistons have been selected. Ford and Plymouth pistons are representative of slotted all aluminum alloy types that are required to be produced in large quantities. Next, De Soto, Dodge and the Graham-Paige 610 offer a study of Nelson pistons of fairly large quantity production. The Continental Motors line-up is indicative of conditions requiring considerable flexibility of the line for different sizes of pistons. The Chrysler 77 piston represents the medium priced group, and the Packard piston the high priced.

For purpose of comparison the following hypothetical sequence of major operations was formulated, as nearly as possible conforming to the average sequence.

1. Center skirt and head
2. Rough turn OD, head and grooves
3. Rough bore and ream the pin hole
4. Drill oil holes
5. Saw horizontal slots between head and skirt
6. Saw expansion slot in skirt
7. Semi-finish pin hole
8. Recenter skirt
9. Finish turn OD, head and grooves
10. Grind OD
11. Finish ream pin hole

Centering the skirt, consisting of facing and counterboring and in most cases chamfering, is performed first by all companies using a strutted type of aluminum alloy piston. Dodge waits until after roughing the piston and milling the slots between head and skirt before chamfering. The second operation which generally follows or is performed simultaneously is that of centering the head. Ford, however, does not center the head at any stage, doing no work between centers, and using the OD mainly for locating. Packard recenters the head later to the pinhole after line reaming, before finish grooving and slotting the skirt. Lathes are universally used for the above operations.

Rough turning the OD generally follows the centering of the pistons, using the centers for locating. Exceptions include Dodge which does not rough turn until after cutting the horizontal slots between head and skirt. Of course, this represents a difference of opinion, of whether the distortion occurring after milling the slots should be taken care of in the rough turning or whether it is better to provide for it in the finish turning.

Rough facing the head is almost universally performed together with roughing the OD, since the principles involved bear a close relationship, and lathe operation facilitates a tool layout for such a purpose. An exception noted is Continental Motors, which does not rough the head at all, but finish faces it directly later.

Divergence Increases

From this point on practice begins to diverge ever wider. Rough grooving, performed by Chrysler, Ford, Dodge, Packard and Plymouth simultaneously or closely following roughing the OD, chiefly on semi-automatic or full automatic lathes, is reserved until after line reaming the pin hole and correcting the skirt center to the pin hole by Continental, thus enabling it to finish the bottom diameter of the grooves directly with stellite. Graham-Paige does almost the same thing, except that the grooves are roughed after the semi-finish reaming of the pin hole, recentering of the skirt to the pin hole and finish turning the OD, thus enabling it to rough and finish groove in one operation, using two sets of grooving tools.

In rough boring the pin hole, where the major questions are correct location as to height, centering in the pin boss and squareness with the skirt, widely varying methods are used by the different companies to achieve

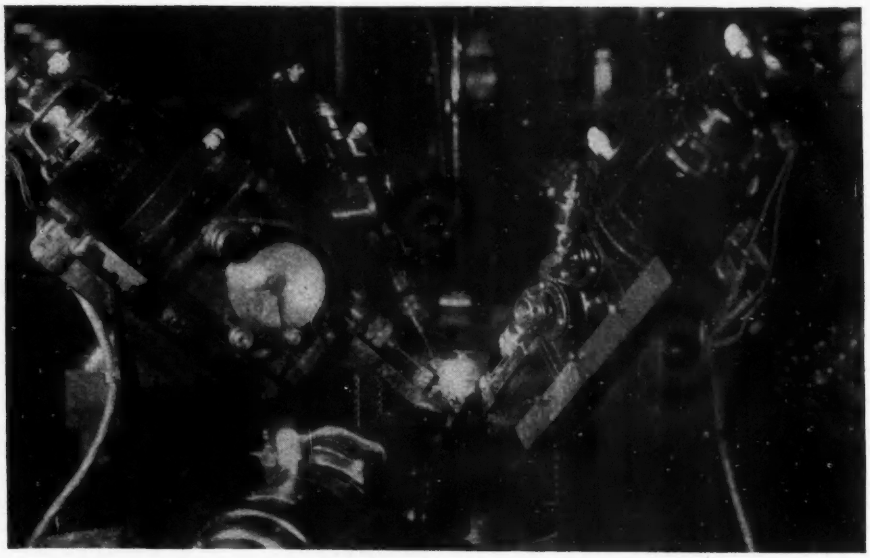
TABLE II

(Bore Pin Hole Slotted Piston)

Company	Locate	Machine	No. of Pistons	Piloted	Head facing?	Skirt slot?	Head slot?	Opposed feed?	OD?
Chrysler	Counterbore	Avey (double)	2	Yes	Roughed	No	No	No	Roughed
Continental	Centers	S S drill	1	Yes	None	No	No	No	Roughed
De Soto	Pin boss and counterbore	S S Avey	1	Yes	Roughed	No	No	No	Roughed
Dodge	Pin boss and counterbore	S S Avey	1	Yes	Finished	No	Yes	No	1st grind
Graham-Paige	Counterbore and pin boss	3-S Barnes	1	No	Roughed	Yes	Yes	No	Roughed
Ford	Pot chuck OD center within pin plug	16-S Special	8	No	Finished	No	Yes	Yes	1st grind
Packard	OD pot chuck center with pin hole plug	5-Station Superior Auto	1	No	Roughed	No	No	Yes	Roughed
Plymouth	Counterbore	Cinci. S S	1	No	Roughed	No	No	No	Roughed

The above table indicating the points in the machining lines where the pin hole is rough bored illustrates divergence in machining practice.

these ends. Chrysler, De Soto, Graham-Paige and Plymouth locate from the open end as to height and squareness, using a Vee block spring rest for the pin boss to obtain centering. This permits, of course, the rough boring of the pin hole immediately after roughing the rest of the piston. Misalignment of the pin hole, due to later sawing of the various piston slots, is relegated by these companies for correction to the later line reaming operation. Graham-Paige of the companies mentioned above is an exception, sawing both the horizontal slots below the head and the expansion slot before rough drilling the pin hole.



Individual electric high-speed drill heads are frequently used in piston machining, either singly or in combination of as many as 12 or 13. This photo shows the drilling of the pin boss oil holes and expansion slot relief by Dodge Brothers

Dodge, while is does not saw the expansion slot before rough boring, does saw the horizontal slots. This company belongs to the second group, locating from the rough ground OD for squareness and the finish faced head for height. Its gun drill is piloted in the fixture both top and bottom. Other companies locating from the rough ground OD include Ford, who uses a pot chuck with height locating from the finish faced head and centering by means of a pin plug. For rapidity, double opposed spindles, as in cast iron machining practice, are used by Ford.

Packard also uses opposed feed and a pot chuck, locating by means of a pin hole plug and locking the piston by means of the roughed OD in a five-station Superior automatic. Continental, on the other hand, locates its piston between centers as in the previous lathe operations, obtaining squareness from the skirt face. It performs this operation before facing the head.

Rough Reaming Similar

In every case investigated, rough reaming the pin hole either was performed in the same set-up or in the next operation, or else, as in the case of Dodge and Ford, the tool was of such a character as not to require rough reaming. Semi-finish reaming was also performed in the same set-up or in the next following by Graham-Paige, De Soto, Plymouth and Packard. Chrysler, however, postpones semi-finish reaming until just before line reaming, after the finish grind of the OD. Continental does not find an intermedite semi-finish reaming necessary, going immediately to line reaming of the pin hole. The same is true for Dodge. Ford, also, does not semi-finish, reserving the finish machining for the last.

As to the sequence into which drilling pin boss oil holes falls in various machining lines with relation to pin hole machining, Continental, Chrysler and Dodge perform it after rough reaming, Graham-Paige and Packard before any boring on the pin hole, De Soto after semi-finish reaming, and Plymouth just before the line reaming and sizing of the hole. The type of equipment varies from single-spindle high-speed drills, with no locating except for guides, to special drilling machines with multiple drill heads, arranged at various angles, using pot chucking, etc.

Sawing the horizontal slots between head and skirt is performed by all companies investigated before finish grooving, since it may, by relieving internal strains, change the squareness of the grooves with the skirt, etc. For the same reason it is not performed after finishing the OD. Just at what stage of machining of the OD grooves and also of the pin hole the horizontal slots should be sawed, however, seems to be a controversial question. Dodge does it before doing any machining, immediately after countering the piston, thus taking care of distortion in the roughing operation. On the other hand, Packard finish turns the skirt and semi-finish reams the pin hole before splitting, taking care of the necessary corrections in the final OD grinding, semi-finish and finish grooving and pin hole diamond boring.

In between are found the rest of the companies investigated. All of these perform the sawing of the horizontal slots before finishing the OD and grooves. With respect to the pin hole, this operation finds the Ford and Graham-Paige pistons untouched, the Chrysler piston rough reamed, De Soto and Plymouth semi-finish reamed, and the Continental piston line reamed. Ford, incidentally, does not saw the horizontal slots, but cuts them with the ring grooves.

Neither does there seem to be a definitely selected spot in the piston machining line where everybody is agreed that the expansion slot should be sawed. Graham-Paige, De Soto and Plymouth saw it immediately following the horizontal slot sawing, at which point the OD is rough turned.

On the other hand, Dodge, Continental and Ford rough grind the OD's before sawing the expansion slot, leaving it up to the finish grind to correct the OD for taper if necessary. Packard is midway between, with the pin hole line reamed, but not sized, and the OD finish turned but not ground. Chrysler, on the other hand, completely finishes its piston before sawing the expansion slot.

Expansion Slot Practice

The stage at which the expansion slot is sawed naturally affects the method of obtaining the skirt eccentricity generally desired. Ford pistons do not call for any, and the finish grinding is centerless. Dodge, Continental, Packard and Plymouth have no subsequent OD machining and obtain the desired eccentricity by means of adjustment of the tail stock center tension in grinding.

Chrysler previously obtained the eccentricity by cam-turning the OD. De Soto in its finish machining locates from the counterbore rather than the chamfer and also obtains the eccentric skirt by tail stock tension adjustment. Graham-Paige finishes machines the OD in two operations, but recenters the skirt twice before finally finish grinding between centers, correcting for taper. It obtains the desired eccentricity also by tail stock tension.

As has already been mentioned, horizontal slots between head and skirt are generally sawed before finish turning the OD. Since it is general practice to perform the latter between centers, it therefore becomes necessary to recenter the skirt. In those cases where the expansion slot is also sawed before finishing the OD, it is necessary to correct the skirt center for this as well. Moreover, since the OD should be squared up with the pin hole before the final turning or grinding, machine tool operations are generally so arranged that the corrective centering for both types of slots can be combined in one operation, after at least semi-finishing the pin hole. The usual manner of correcting then is on a lathe in a pot chuck, using a pin plug to locate for squareness.

Corrective Centering

Exceptions in the cases investigated include Graham-Paige, which corrects twice, as already mentioned, once after sawing all slots and semi-finishing the pin hole for finish turning the OD, and once later before the finish grind between centers to take care of any distortion occurring in intermediate operations. Continental also corrects twice, once to the pin hole after sawing the horizontal slots and before rough grinding between centers to take care of any distortion occurring in intermediate operations. Continental also corrects twice, once to the pin hole after sawing the horizontal slots and before rough grinding between centers, and once after sawing the expansion slots. In the latter case, however, the operation is merely a truing up of the center on a hand feed drill press before the finish grinding operation. In both cases the pin hole had been previously line reamed but not finally sized. Another deviation in correcting the skirt center to the pin hole is by Plymouth, which uses the head for locating, drawing it up against the lathe drive plate by a plug through the pin hole. Ford does not recenter, as it locates, after splitting, mainly from the OD.

Going now to the semi-finish OD, head and ring groove turning operations, it is found that these, more usually than not, are combined or closely follow one another. In the case of Graham-Paige and Packard, OD, head and land turning are combined, and in either case are followed immediately by a lathe operation with two sets of cutters for machining the ring grooves twice, Packard using stellite tools. In place of the three-operation final grinding by Packard, Graham-Paige grinds once, preceded by another turning. De Soto and Chrysler combine OD, land and finish ring groove turning, reserving the finish head facing until after the final OD grinding. Ford machines all except the lands on the same five-station Mullard Multaumatic, which is also used for the corresponding roughing operations. The lands are ground with the rough OD on a centerless grinder without through feed, using a stepped diamond-dressed wheel.

Plymouth has found it possible to eliminate finish turning the OD, merely turning the head and ring grooves, and to follow it up with finish grinding, after which the head is faced parallel with the skirt face. Dodge and Continental also do not finish turn the OD, but grind in two steps. Dodge does this once before boring the pin hole and once as the last operation, preceded by finishing the lands on a taper grinder. In this case the head is finished before the first grind, except for the removal of the centering boss, which is spot faced off after finish grinding. Finish grooving is also reserved until just before final grinding.

The reverse is true of Continental, where the first grind follows the line reaming of the pin hole and recentering, followed by rough grooving with stellite, land finishing, finish facing the head, finish grinding and then ring grooving.

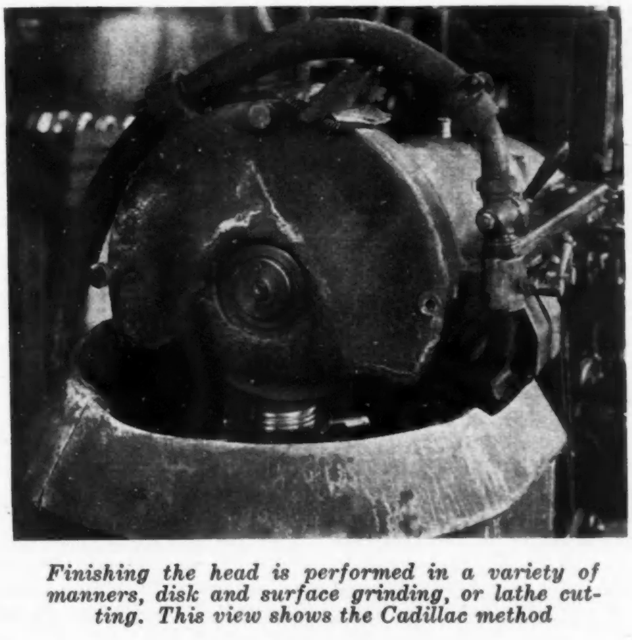
In the majority of cases investigated the finish OD grinding precedes line reaming of the pin hole. This applies to De Soto, Graham-Paige, Chrysler, Ford and Plymouth. Packard and Continental, however, line ream before grinding, only a sizing of the pin hole following. Dodge, moreover, completely finishes the pin hole before finish ring grooving.

In all three of the above cases, Dodge, Continental and Packard, there is a recentering of the skirt before line reaming the pin hole. In the case of Continental, only the horizontal slots have not been sawed before line reaming.

Drilling Smoke Holes

While it would appear that the drilling of smoke holes in the lower ring groove might be susceptible to standardization, the investigation shows that Graham-Paige and Ford drill them after finish grooving, while Continental, Dodge and Packard drill them after rough and before finish grooving. De Soto and Chrysler do not have smoke holes, the horizontal slots being located in the lower ring groove, connected with the opening around the pin boss by means of short vertical slots through the lowest land. For cutting these Chrysler has developed special machines with four heads having a shaper-like action.

Drilling smoke holes, incidentally, is performed on a variety of machine tools, ranging from single-spindle drill presses with hand rotation of the piston in a V block provided with a guide for the lower ring groove, through automatic indexing fixtures in connection with single-head reciprocating horizontal drills, to radial drills drilling all holes at once. The first has the advantage of flexibility where several types of pistons have to be run over the same line; the second has the advantage that it does not gen-



Finishing the head is performed in a variety of manners, disk and surface grinding, or lathe cutting. This view shows the Cadillac method

erally require an extra operator to take care of it, and the last the obvious advantage of high quantity production.

Finishing the pin hole is more generally performed by line reaming and burnishing on burring heads. Continental substitutes rolling for burnishing. Chrysler does its line reaming on a lathe, followed by burnishing on a bench burrer, and De Soto and Ford diamond bore.

Continental Motors Corp.

Due to the fact that several different sizes of pistons have to be run over this line, it has been made as flexible as possible. The piston is first centered, then roughed out and wristpin hole finished, all between centers. After slotting, the centers are corrected to the pin hole and used for locating in the major remaining operations, including rough and finish machining ring grooves with stellite. Before finish grinding the O. D., the skirt is slotted and the piston recentered to correct for any eccentricity. Finish cutting of ring grooves is also reserved until the end of the machine tool operations at the Continental plant.

In sequence the Continental operations are as follows:

1. Bore and face open end and center closed end on J. & L. lathe with expanding chuck.

2. Chamfer open end on Cincinnati drill.

3. Rough turn OD on Fay automatic between centers.

4. Rough drill and semi-finish drill pin hole on single-spindle hand-feed drill with quick-acting tool chuck in spindle. Locating of the piston is between centers. Cutting tools are piloted in the fixture both top and bottom.

5. Drill holes in pin boss on hand-feed drill press.

6. Align ream pin hole on bench burring head.

7. Saw horizontal slots on single-cutter hand-feed miller, locating from pin hole and OD.

7a. Wash.

8. Finish face and chamfer skirt on hand-feed lathe, locating by a pin plug in a pot chuck.

9. Rough grind OD on Norton between centers.

10. Cut lock retainer rings in pin hole with expanding tool on bench burrer.

11. Rough machine ring grooves with stellite and rough OD of lands, and finish bottom diameter of ring grooves on Fay automatic, locating between centers with pin boss drive. In this operation skirt oil grooves are also cut.

12. Face head on semi-automatic lathe. Locate from open end face with plug through pin hole and spindle attachment to draw skirt against driving head. Centering is through spring-mounted skirt chamfer center. A multiplying indicator is installed on this machine for accurate machining for height above pin hole.

13. Drill expansion slot relief hole on hand-feed drill.

14. Saw expansion slot on hand-feed miller, locating pin hole in pot type fixture.

15. Drill smoke holes in lower ring grooves on high-speed hand-feed drill press. Piston indexed by hand in V block rest with guide for lower groove. A glass visor is provided in front of this machine to permit close observation of hole spacing without danger from flying chips.

16. Burr piston with wire brush.

17. Chamfer open end on hand-feed drill to correct for expansion slot without locating.

18. Taper grind skirt OD on Norton grinder between centers. Eccentricity desired is obtained by accurate adjustment of the tail stock center to provide .002 in. expansion. Also burr and chamfer top and bottom of piston with file.

19. Finish cut ring gooves to width on Sundstrand stub lathe with piston between centers. Also burr ring grooves and chamfer slightly for ease of ring assembly, with tension control for tail stock centers.

20. Burr, ream and roll wrist pin holes in three operations on burring heads.

21. Wash, inspect and assort in sets to weight, holding to ¼ oz. in each set.

Ford Motor Co.

The piston manufactured by Ford, while all aluminum, resembles the Nelson type closely in that the normal invar strut is replaced by an aluminum cast in strut. Due to the higher skirt clearance provided, however, it is not necessary to machine an eccentric skirt. Close limits are adhered to, however, with a 4 gram. tolerance for weight and .003 in. allowance in squareness of the skirt with the pin hole.

Since extremely high production rates are required on but one type and size of piston, and it is also desired to keep down the manpower, special purpose machinery is largely used, including a Bullard Multaumatic for most of the roughing and finishing machining operations. No skirt center correction is made for eccentricity after machining the pin hole or slotting, locating and sequence of operations being arranged to make this unnecessary. However, as a check an inspection for squareness of the skirt with the pin hole is made immediately after finish machining the latter.

In sequence the Ford operations are as follows:

1. Counterbore and face open end on lathe, using an expanding chuck for holding the piston, with a four-point bearing on the OD, made possible by double collets for the four pins of the chuck. A ball bearing revolving center in the tail stock serves as a steady rest for the head, and to obtain squareness, the piston being required to be cast square when received, to make this manner of locating possible.

2. A Bullard Multaumatic is next used, having five working heads and one loading station. Locating is from the open end counterbore. The heads perform the following operations in sequence:

a. Rough turn OD and face head.
b. Rough cut ring grooves and slot skirt from head.
c. Chamfer lower ring groove and finish face head.
d. Finish turn OD.
e. Finish cut ring grooves.

3. Rough grind the OD and lands on Cincinnati centerless with in-feed for wheel, the latter being automatically diamond-dressed and stepped. Diameter is held to .002 in. in this operation.

4. Rough ream wrist pin hole on Ford standard 16-spindle rotary drill press. Locating is in pot chuck, these being arranged in sets of four. With double indexing two operators load eight pistons while eight are being machined. With single index one operator loads four pistons.

5a. Semi-finish ream pin hole on hand drill, locating in pot chuck, with reamer piloted in bushings both top and bottom.

6. Inspect pin hole for squareness.

7. Burr pin hole on burrer, a boring bar with collapsible spring-mounted inserted blade being used, so that both inside edges and outside edges of pin holes can be burred in one operation.

8. Burr saw slot between head and skirt on continuous feed rotary mill, locating from the counterbore. The piston in this operation is not locked in place.

9a. Three-quarter finish ream pin hole to .002 in. on single-spindle hand drill, locating from OD in pot chuck, and using piloted expansion reamer.

10. Drill smoke holes in lower ring groove on 12-head radial drill with pot chuck for piston in center. All heads are driven by means of a single belt from one motor, the belt running down from one head, under an idler, and up to the next head, etc., around the radial drill.

11. Counterbore piston to weight on a special Ford automatic counterborer. The operator on this machine weighs the piston on a scale at his side, sets the weight arm on a scale mounted on the machine tool to correspond with his reading, inserts the piston and starts the machine. Below the tool, which feeds up into the piston, the whole being set at an angle, is a chip collector consisting of a conical pan suspended from the scale arm. When the amount of chips

corresponding to the scale setting has been collected, the arm drops, forms an electrical contact in a mercury cup and trips the machine. As the piston is removed, the chips in the collector dump out through the center of the pan, an inverted cone being provided for this purpose, which kicks up automatically and drops again to close the bottom of the pan. Locating in this operation is from the OD in a pot chuck with the piston clamped against the open end face by a cam-operated clamp on the piston head.

12. Saw inclined skirt slot on Frew hand miller. In this operation, at the end of the stroke, a cam action operates a punch which stamps "front" on the correct piston side.

14a. Line ream pin hole on burrer, using kerosene as a cutting fluid.

15. Finish grind OD on centerless Cincinnati with diamond-dressed wheel, undercutting head .016 in. and taper .001 in.

5b, 9b and 14a.—In place of operations 5a, 9a and 14a, pin holes are also diamond bored on a two-spindle Coulter automatic, locating from pin hole and clamping against side of OD with swiveled clamp connected to an automatic ejector. Spindles run at 3500 r.p.m.

16. Dress ring grooves and chamfer skirt end with files.

17. Wash on gravity conveyor, also provided with heated air to bring piston to correct temperature for inspection while drying.

Graham-Paige Motors Corp.

In point of view of machining time, Graham-Paige has an unusually fine piston machining layout. In general, the piston is first rough out on OD and both ends, is then slotted completely on one machine tool, after which the pin hole is finished except for line reaming, on a three-spindle drill press. Care is taken to obviate against skirt distortion during machining by recentering twice, once before semi-finishing and once before grinding on an arbor. Pin holes are finished by line reaming.

Graham-Paige operations follow in sequence:

1. Face, rough bore and chamfer open and center head end on B. & O. screw machine with expanding air chuck, using hooked tool for skirt boring.

2. Rough OD, face head and chamfer skirt OD on Sundstrand stub lathes, locating between centers. Skirt turned to plus or minute .005 in.

3. Drill expansion slot relief hole on hand-feed Demco drill press.

4. Drill pin boss oil holes on hand-feed Demco drill press.

5. Mill one vertical and two horizontal slots on Superior hand mill with two blades on a single arbor, one for horizontal and for expansion slotting, there being two fixtures, in both of which locating is from the open end and pin hole. The guards over the blades are pushed back by the piston while feeding in.

6. Drill, rough ream and semi-finish ream pin hole on three-spindle Barnes drill with four-station indexing table, locating from counterbore with cam lock on head. The semi-finish ream is held to plus or minus .0005 in.

7. Rechamfer and rebore skirt end on LeBlond lathes, locating from pin hole in pot chuck.

8. Semi-finish turn OD, finish face and chamfer head on Sundstrand stub lathes, locating from counterbore. In this operation the skirt held to .0015 in., plus or minus.

9. Rough and finish turn ring grooves and fourth land on Sundstrand stub lathes, locating from counterbore and skirt face.

10. Drill smoke holes on double head Kingsbury automatic drill with ratchet index for piston. The operator on operation 9 also performs this operation.

11. Finish turn skirt on LeBlond lathes, locating between centers, with .015 in. feed and 550 ft. p. m. cutting speed.

12. Rechamfer open end on hand-feed Cincinnati, locating from pin hole.

13. Finish grind skirt between centers on Norton grinder, removing .005-.006 in. Piston rotates 425 ft. p. m., with cutting wheel running 1260 r.p.m.

14. Finish line ream pin hole on bench.

Packard Motor Car Co.

Exceptional care in the finishing of its piston is characteristic of the Packard machining line, as is evidenced by final grinding of the OD in three steps after slotting the skirt. Two line reaming operations on the pin hole are also performed with .00015 in. tolerance for diameter and .0005 in. at 1 in. radius for squareness with skirt. In general, location is from the open end until the pin hole is rough line reamed. After this both ends are recentered for finish machining.

Packard operations in sequence are as follows:

1. Rough bore and chamfer open end and center head end on a hand-feed lathe with expanding chuck.

2. Rough OD, head and ring grooves on a semi-automatic J. & L. lathe, locating from the counterbore.

3. Rough and semi-finish drill and rough ream pin hole; also, cut retainer ring groove in pin hole with expanding cutter and line ream, all on a Superior automatic horizontal drill with drum indexing and six cutting stations. Location is from the skirt face and head between centers, and opposed feed is used on the roughing operations. This operation is also performed on a Bausch 10-spindle drill with six station indexing tables, two pistons being loaded while eight are machined.

4. Semi-finish turn OD and head and finish turn lands and skirt face on a J. & L. lathe.

5. Drill smoke holes on radial drills.

6. Drill relief hole for expansion slot.

7. Saw expansion and horizontal slots on single-cutter miller.

8. Finish face head on lathe locating from pin hole and skirt face.

9. Cut eccentric groove in skirt, locating from pin hole.

10. Recenter skirt.

11. Line ream pin hole.

12. Recenter head.

13. Finish turn ring grooves on lathe with two sets of stellite cutters, locating between centers.

14. Rough grind between centers on Norton grinder to .003 in.

15. Semi-finish grind on Norton between centers.

16. Finish grind on Norton between centers.

17. Line ream pin hole on burrer, removing .0012 in.

Plymouth Motor Corp.

An all-aluminum alloy piston is used in the Plymouth, fitted with tungtite rings, requiring the undercutting of central lands. There is no pin lock, the pin floating in the piston. Machining practice is comparable, however, to Nelson types. In general, the piston is first roughed out, the pin hole semi-finished, the piston recentered to the pin hole after sawing the slots, after which the piston is finished outside, the centers are removed and the pin hole finished. Features of the line-up are the use of a Lo-Swing automatic lathe for roughing and the operations.

The machining arrangement in sequence are as follows:

1. Rough bore, rough face and chamfer open end and center head end on B. & O. special screw machine with expanding air chuck.

2. Rough turn OD, ring grooves and head and form head radius on an automatic Lo-Swing lathe between centers. Rough facing of the head is up to the centering boss.

3. Rough and finish drill and rough ream the pin hole on Cincinnati drills with hand feed and magic chucks, locating from the skirt end.

4. Drill expansion slot relief hole.

5. Saw slot between head and skirt on Kent Owens hand miller, locating from the counterbore.

6. Saw expansion slot on hand miller.

7. Finish bore and finish face open end on B. & O. lathe, locating from the pin hole and head end.

8. Finish bore head and ring grooves on LeBlond lathe between centers.

9. Finish grind OD on Norton grinder between centers.

TABLE III

(Slotted Pistons)

Company	HEAD SLOT (After) Pin hole	OD	Groove	SKIRT SLOT (After) Pin hole	OD	Grind centers	Subsequent OD locating
Chrysler	1st ream	Roughed	Roughed	Finished	Finished	Yes	None
Continental	Line ream	Roughed	None	½ fin.	Rough gr.	Yes	Centers
De Soto	½ fin. ream	Roughed	Roughed	½ fin.	Rough	Yes	Centers
Dodge	None	None	None	Finished	Rough gr.	Yes	Centers
Ford	None	Rough	None	½ fin.	Rough gr.	No	None
Graham-Paige	None	Rough	None	None	Rough	Yes	Centers
Packard	Semi-fin.	Fin. turn	Rough	Line ream	Fin. turn	Yes	Centers
Plymouth	½ fin. ream	Rough	Roughed	Semi-fin.	Rough	Yes	Centers

Machining of light alloy pistons is complicated by the necessity for slotting the head from the skirt and providing an expansion slot in the latter. Just when these slots should be sawed is evidently open to argument, as the above table indicates.

10. Finish race head and remove center on Star lathe, locating from pin hole and open end face for squareness.
11. Drill two holes in pin boss on two-spindle Aveymatic drills.
12. Drill 12 smoke holes in lower ring grove on a radial drill.
13. Finish ream and burnish pin hole on high-speed bench burrer. Tool reamer is multiple-blade left-hand spiral with right-hand cut.
14. Burr lower ring groove inside and out.
15. Inspect.

Dodge Brothers, Inc.

An unusual feature of the Dodge piston machining line is that the horizontal slots are sawed before any operations except the centering of the piston head and counterboring. Even centering the skirt end is reserved until after sawing. In this manner no corrections are necessary later for any distortion occurring from the relieving of internal strains by sawing. Finish machining is all referred to the pin hole. An interesting gun drill is used for boring the latter, requiring only a line reaming and burnishing later.

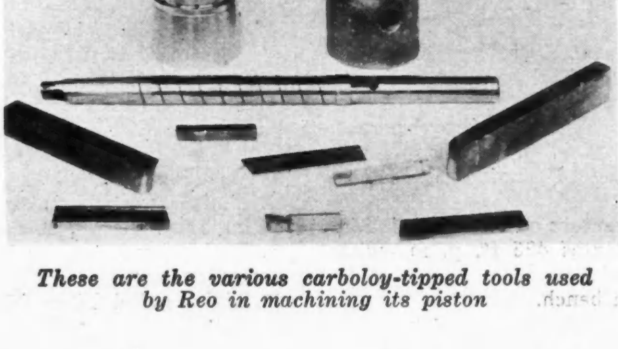
Operations in sequence follow:

1. Face and bore open end and center head end on W. & S. turret lathe with external chuck. A truing cone on one side of the turret is provided for rough centering the piston in the chuck. The head end centering drill is fed through the drive spindle.
2. Saw slots between head and skirt on Steptoe hand miller, Superior or Kent-Owens, the latter with two cutters, the first two with one. Locating is from counterfore and skirt face.
3. Rough turn OD, rough groove and rough face on a Fay automatic lathe, locating from head center, and skirt face and counterbore.
4. Chamfer open end on hand-feed drill press, locating from the rough pin hole, and head end center, the pin for the latter being spring-mounted.
5. Reface head, rough turn top three lands and finish turn lower two lands on Chard lathe, locating between centers. Also chamfer top and bottom of piston.
6. Rough grind OD on Norton grinder between centers.
7. Gun drill pin hole on single-spindle Avey with automatic feed, locating from head face with spring jaw blocks for pin boss rest. The pin hole in this operation is held to .0007 in.
8. Cut oil groove in both ends of pin hole on Avey. Piston rests in V block with plug for pin hole locating below spindle. Expanding cutter.
9. Drill pin boss oil holes and expansion slot relief hole on special five-head Kingsbury drilling machine. Locating is from side of skirt, which is automatically clamped against internal plug as drills begin to feed.
10. Burr pin hole on bench burring heads.
11. Line ream pin hole on burring heads.
12. Burnish pin hole on burring head.
13. Drill smoke holes on Kingsbury four-spindle drilling machine, four pistons at a time, with ratchet index for pistons. One operator takes care of two machines.
14. Saw expansion slot on Steptoe hand miller.
15. Rechamfer open end on Porter-Cable lathe with quick-acting tail stock center to correct eccentricity after slotting.
16. Finish turn ring grooves on Chard lathe, locating between centers.
17. Burr ring grooves on lathe with file.
18. Finish grind top three lands, on Norton grinder between centers.
19. Finish grind OD between centers.
20. Wash.
21. Remove centering boss on head end on Allen drill press with hand-feed spot facing tool. Fixed stop on spindle. Locate from open end face.
22. Wash and sort for sizes.
23. Weigh and stamp in sets.

All operations are connected by an overhead conveyor.

De Soto Motor Car Co.

The piston used by this company is of the Nelson type. In place of smoke holes it has the slots between head and skirt sawed in the lower oil groove, these slots being connected to the opening around the boss by slots through the lower land cut on special machines. In general, the piston is first roughed out complete and the pin hole semi-finished. After sawing all slots, the open end is corrected to the pin hole with finish machining between centers and diamond boring of the pin hole.



These are the various carboloy-tipped tools used by Reo in machining its piston

Operations in sequence follow:

1. Rough bore, face and chamfer open end and center head on B. & O. screw machine between centers.

2. Rough OD, grooves and head on LeBlond Multicut or Lo-Swing automatic between centers.

3. Rough core drill pin hole on Avey drill press, locating between centers.

4. Rough drill and semi-finish ream pin hole on Avey single-spindle drill and piloted tools, locating from counterbore, etc.

5. Saw two horizontal slots in lower ring groove on Toledo hand miller.

6. Drill expansion slot relief hole on Avey hand-feed drill press.

7. Cut four slots through lower land on a special four-head Chrysler machine having a shaper-like action for the heads, 1/16 in. cutters and automatic vertical feed. Locating is from the pin hole.

8. Saw expansion slot on Toledo hand mill.

9. Rebore face and chamfer open end on LeBlond lathe, locating from pin hole in pot chuck.

10 to 12—Drill miscellaneous oil holes on Avey single-spindle drill in three operations, locating from the head face.

13. Finish turn OD groove and chamfer lower ring groove on LeBlond lathe between centers.

14. Finish grind OD between centers on Landis grinder.

15. Finish face head on LeBlond lathe.

16. Diamond bore pin hole on two-spindle Coulter automatic, locating either from the pin hole and skirt face or from the pin hole and side of the OD. Spindle speed is 3600 r.p.m., with .007 in. removed and .0001 in. tolerance for diameter and taper.

17. Wash and blow with air. Select to size in .0005 in. steps.

Chrysler 77

The piston used in the Chrysler 77 is of the Nelson type, with tungtite rings and slots between head and skirt cut in lowest ring groove, eliminating smoke holes. In general, the piston is first roughed out, heads are slotted from skirt and the piston finished. The pin hole is then finished and the expansion slot sawed.

Operations in sequence follow:

1. Bore, face and chamfer open end and center head end on B. & O. lathe with expanding chuck.

2. Rough OD grooves and head face between centers on LeBlond Multicut.

(Continued on page 550)

TABLE IV

(Piston Machining Time)

	A	B	C	D	E	F	G	H	I	J	K
1. Center head, face skirt, counterbore and chamfer	1.20(3)	.70(2)	.91(2)	.56 j	.29(2)	.32(2)	.22 d	.60	.35	.46	.39
2. Rough OD grooves and head	......	.90	.89	.56	.96(2)	1.25(3)	.50 e	.53	.78	.56 b	......
2a. Same plus finish groove	1.80(2)	......	......	......	......	......	......	......	......	......	1.02
3. Finish OD grooves and head	......	.75 m	1.00	2.51(3)	1.21(3)	......	......	......	.99	1.39	......
3a. Same except head	......	......	......	......	......	.94	.46	1.00(2)	......	......	......
3b. Finish OD and head	1.45(2)	......	......	......	......	......	......	......	1.90 f	1.00 a	1.36(2)
4. Total 1 to 3	4.45	2.35	2.80	3.17	2.46	2.51	1.18 k	2.13	4.02	2.85	2.77
5. Recenter skirt	.10	None	None	b	.30	.40	None	.62	.55	.86	.65
6. Horizontal slotting	None	None	None	None	None	.13	b	.19	.19	.38	.41
7. Expansion slotting	None	None	None	None	None	.12	?	.19	.19	.19 a	
8. Drill slot reliefs	None	None	None	None	None	.08	?	......	.54 g	......	.10
9. Total 5 to 9	.10	None	None	None	.30	.73	.20 a	1.00	1.47	1.43	1.16
10. Rough grind OD	1.25	.38(2)	.40	.69	.40	.35	?	.58	None	None	None
11. Finish grind OD	1.50	.64(2)	.50	1.76	.41	.72	?	1.89	1.04	1.00 a	.35
12. Additional OD and land grind	.35	.36 c	1.08 c	1.13 c	.72(2)	None	None	.35	None	None	None
13. Total 10 to 12	3.10	1.38 p	1.98 c	3.58 c	1.53	1.07	1.50 a	1.89	1.04	1.00 a	.35 q
14. Total 4 and 13	7.55	3.73	4.78	6.75	3.99	3.58	2.68 a	4.02	5.06	3.85 a	3.12
15. Total all above	7.65	3.73	4.78	6.75	4.29	4.31	2.88 a	5.02	6.53	5.28	4.28
16. Rough bore pin hole	.60	.24r	.30	1.14	None	......	.25	.47	.25	......	......
17. 16 plus rebore and ream	1.05	.88	.90	2.52	.90	.60	.51	None	.25	......	......
18. 17 plus ½ fin. ream	1.17	1.04	1.26	3.24	.90	.75	.51	.47	1.19	1.05	.33 n
19. Counterbore pin hole or mach. retain. groove or lockscrew	.35	.20	.45	.94	.19	.22	None	.33	.11	......	......
20. Chamfer pin hole	.22	.26(2)	.19	......	......	......	?	.19	......	......	......
21. Finishing pin hole	.30	.37	.36	.76	.68(2)	.30	.60	.38(2)	.39 s	.30	.20
22. Total 18 to 21	2.04	1.87	2.26	4.94	1.77	1.87	1.40 a	1.37	1.69	1.35	.53
23. Drill smoke holes	.33	.24	b	.39	.26	.20	.09	.17	None	.23	b
24. Drill pin boss oil holes	,20	......	......	......	.15	.16	......	.19 h	.91(2)	.21	.30
25. Total 22 and 23	.55	.24	None	.39	.41	.36	.09	.36	.91	.45	.30
26. Remove head center boss	......	......	......	.27	......	......	......	.24	......	.20 a	......
27. Machine to weight	None	None	.70	1.77	None	None	.28	None	None	None	None
28. Sort to weight	?	?	None	None	?	?	None	.25	?	?	.01
29. Misc. additional	.09	.40	.22	1.58	.42	.09	?	.59	?	.20	.16
30. Total 26 to 29	.30 a	.60 a	.92	3.62	.62 a	.30 a	.75 a	1.08	.20	.60 a	.16
31. Total all operations	10.5	6.4	8.0	15.7	7.1	6.8	5.1	7.8	9.3	7.7	5.3

The above table represents machining time in minutes for the various operations, based on the pay-time, generally, rather than on the machine time. So that where one operator performs two operations only his time is taken, not the sum of the times of the two operations.

Pistons A to D are cast iron. Piston E is an unslotted aluminum alloy piston, following cast iron machining practice more nearly. F to K are slotted aluminum alloy pistons of various types and designs.

Note: Figures in parenthesis indicate number of cuts involved, if more than one.

Abbreviations:

a. Approximate
b. Requires no extra operator
c. Includes head grinding
d. Except chamfering
e. Includes No. 6
f. Includes cam turning OD
g. Includes cutting 4 slots through lowest land.
h. Includes No. 8
j. Except head centering
k. On Bullard Multaumatic
m. On automatic lathes
n. On 3-spindle Barnes drill
p. On centerless grinder
q. On arbor grinder
r. Opposed feed horiz. drills, 2 to operator
s. Diamond bore on 2 spindle Coulter

Elimination of Waste in Plants Use of *Non-Productive*

Survey indicates methods used to curb expenditures. to cost-reduction

By JOSEPH

IN a year $75,000 is saved by a prominent car manufacturer by recoating abrasive disks used in preparing body panels.

In one year $8,500 was saved at a large engine plant by means of suitable equipment and methods for mounting cylinder honing stones.

A motor truck manufacturer saved $2,000 in a year by using standard towels as a substitute for wiping rags.

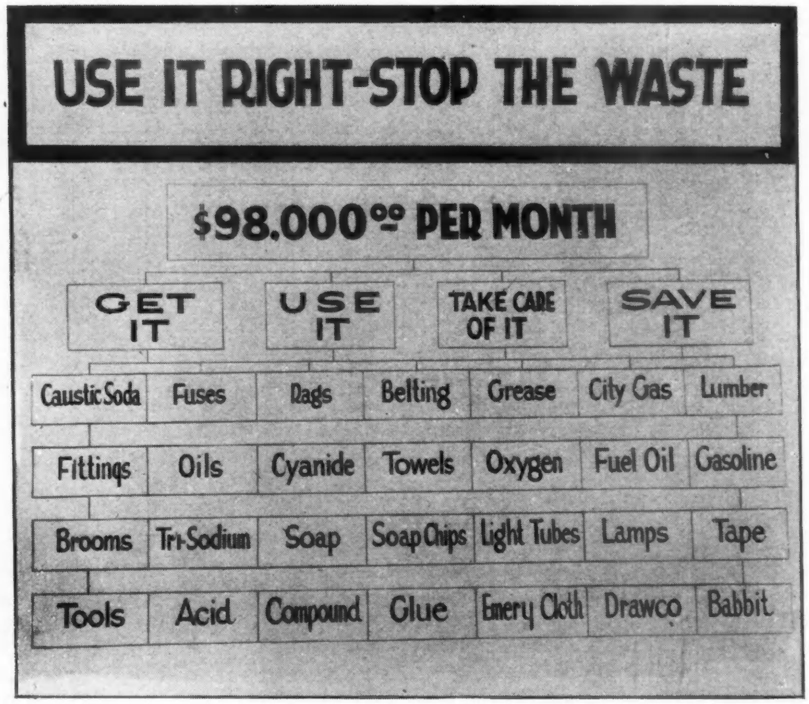
One hundred and fifty thousand feet of lumber is salvaged monthly by a large automobile manufacturer at an aggregate saving of $3,500 per month. This material is salvaged from crates, shipping blocks, and other shipping materials.

The ratio of the non-productive dollar to the productive dollar has been reduced by a prominent parts manufacturer from 66 per cent in 1925 to 37 per cent in 1928.

Another prominent car manufacturer has effected a saving of 67 cents per car in the cost of non-productive materials.

These figures, taken at random, show what is being done by the automotive industry in eliminating waste and effecting economy in the use of material which is not included in any part of the finished product. The variety and cost of such materials used by manufacturers of automotive equipment is a revelation, especially since it represents a heavy burden on the productive dollar, which is eventually reflected in the cost of the unit, or the complete car. To gain a perspective of what is being done to eliminate waste and to control the consumption of these non-productive materials, *Automotive Industries* undertook an extensive survey of some of the prominent manufacturers in and about Detroit. This survey, which just has been completed, has yielded information of practical value to the factory executive and the cost accountant.

It is interesting to find that the really successful systems for waste elimination—those which are producing results—are based upon certain simple fundamental ideas that can be applied to any manufacturing problem. An extension of some of the underlying principles given below, depending upon the nature of the operation, forms the basis of certain of the most comprehensive systems used in the automotive industry.



Bulletin posted in the Oakland Motor Car Co. plant during the "War on Waste" campaign

First, the basic idea is to determine the non-productive materials that are to be controlled, and to work out a simple record system to control their consumption. Naturally, everything depends upon the layout of the plant, the accounting system in use and the magnitude of the operation.

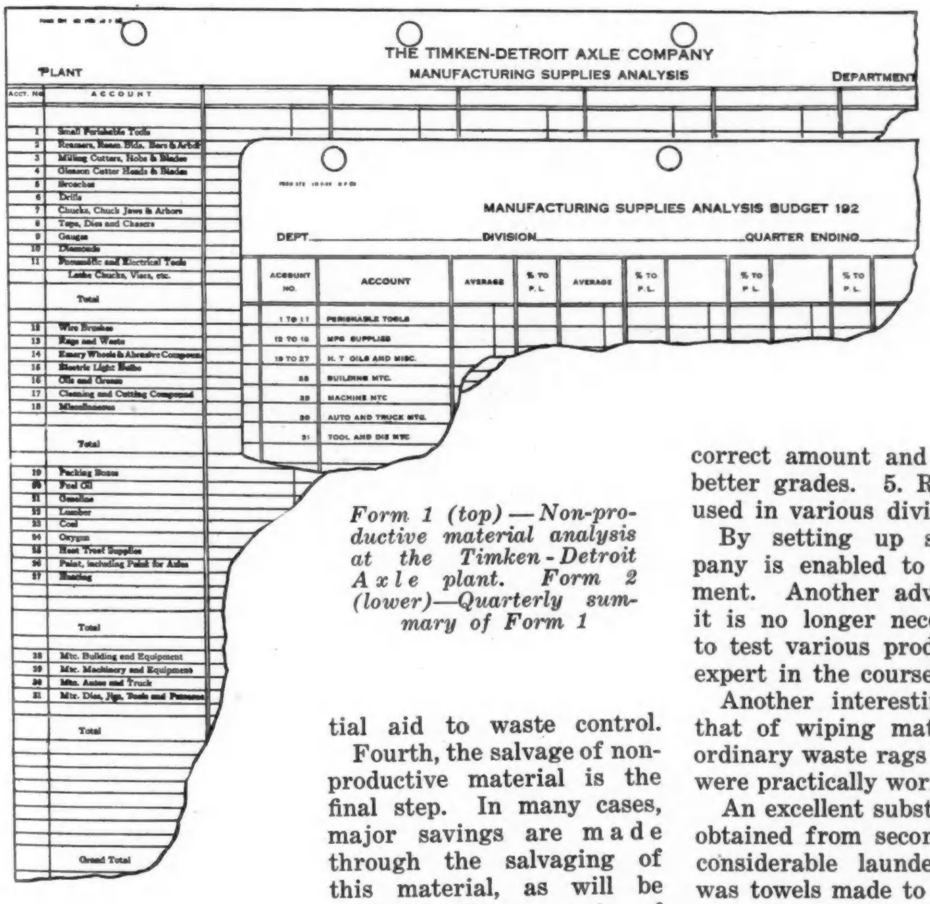
Second in order of precedence, but probably of equal importance, is the idea that the control system must be sold to the operating department, particularly the foreman. It is generally agreed that the men responsible for the use of non-production materials are the ones to look to for the success of any control system of this nature. In practice, selling the idea is accomplished by submitting periodic reports to the foreman, showing his expenditures of such materials.

Third, the standardization of materials is another important factor. And wherever the size of the operation warrants it, a standards organization is an essen-

Is Accomplished *by Controlling* Materials in *Manufacture*

in large automotive factories Foremen found to be key by close supervision.

GESCHELIN



THE TIMKEN-DETROIT AXLE COMPANY
MANUFACTURING SUPPLIES ANALYSIS

PLANT — DEPARTMENT

ACCT. NO.	ACCOUNT
1	Small Perishable Tools
2	Reamers, Ream. Blds, Bars & Arbors
3	Milling Cutters, Hobs & Blades
4	Gleason Cutter Heads & Blades
5	Broaches
6	Drills
7	Chucks, Chuck Jaws & Arbors
8	Taps, Dies and Chasers
9	Gauges
10	Diamonds
11	Pneumatic and Electrical Tools
	Lathe Chucks, Vises, etc.
	Total
12	Wire Brushes
13	Rags and Waste
14	Emery Wheels & Abrasive Compounds
15	Electric Light Bulbs
16	Oils and Greases
17	Cleaning and Cutting Compound
18	Miscellaneous
	Total
19	Packing Boxes
20	Fuel Oil
21	Gasoline
22	Lumber
23	Coal
24	Oxygen
25	Heat Treat Supplies
26	Paint, including Paint for Axles
27	Heating
	Total
28	Mtc. Building and Equipment
29	Mtc. Machinery and Equipment
30	Mtn. Autos and Truck
31	Mtc. Dies, Jigs, Tools and Patterns
	Total
	Grand Total

MANUFACTURING SUPPLIES ANALYSIS BUDGET 192

DEPT.______ DIVISION______ QUARTER ENDING______

ACCOUNT NO.	ACCOUNT	AVERAGE	% TO P. L.	AVERAGE	% TO P. L.		% TO P. L.		% TO P. L.
1 TO 11	PERISHABLE TOOLS								
12 TO 18	MFG. SUPPLIES								
19 TO 27	H. T. OILS AND MISC.								
28	BUILDING MTC.								
29	MACHINE MTC								
30	AUTO AND TRUCK MTG.								
31	TOOL AND DIE MTC								

Form 1 (top) — Non-productive material analysis at the Timken-Detroit Axle plant. Form 2 (lower)—Quarterly summary of Form 1

tial aid to waste control.

Fourth, the salvage of non-productive material is the final step. In many cases, major savings are made through the salvaging of this material, as will be shown in latter parts of this article. A simple way to control salvage without an involved system is to check the final disposition of all used materials. Delegated authority at this point often results in many interesting salvage operations and economies.

One prominent manufacturer, because of the diversity of its operations, handles non-productive materials by a centralized control. Heads of departments meet at intervals to study specific non-productive materials brought forward by the purchasing agents and plant efficiency men. When a certain material is scheduled for study, the problem is turned over to an expert, who calls on all departments and studies the uses and varieties of this material.. Among the major items that have been already studied are the following: 1. Metal Cleaners. 2. Janitor's supplies. 3. Buffing wheels. 4. Buffing compounds. 5. Nickel salts. 6. Rust preventatives. 7. Wiping materials. 8. Belting. 9. Sandpaper, emery cloth. The final results of a survey supply the expert or coordinator with really valuable information. Some of the important elements are given below:

1. Formulation of standard specifications. 2. Suggestions for substitutes, if possible. 3. Determination of correct amount and proper use. 4. Determination of better grades. 5. Reduction in varieties of materials used in various divisions.

By setting up standard specifications, the company is enabled to centralize its purchasing department. Another advantage of standardization is that it is no longer necessary for individual departments to test various products, because this is done by the expert in the course of the survey.

Another interesting example of standardization is that of wiping materials. Investigation proved that ordinary waste rags were not satisfactory, because they were practically worn out before they were put into use.

An excellent substitute was found in ticking material obtained from second-hand mattresses, since it stands considerable laundering. However, the final choice was towels made to a standard size and with specifications covering strength and other important properties. Towels are now used exclusively. They are drawn out by the men on requisition in the same manner as small tools or other non-productive materials. Savings through the use of toweling are notably larger.

At the Timken-Detroit Axle Co., J. W. Brussel, works manager, has installed a comprehensive control system which is well worth studying. Form 1 shows in detail the non-productive accounts used in the factory. Each item has a separate account number and is separately considered. Note the separation and segregation of various types of non-productive materials. This form is a detailed analysis by departments. When completely filled out, it shows in dollars the usage for the previous year, the present quarter and the current month in comparison.

Central Stores Copy

CENTRAL STORES DISBURSEMENT REPORT

Cylinder Block & Brg. Cap - Pon.

DEPT. 960

8.8 UNITS 2nd HALF OF September

MATERIAL NAME	Catalog Number	Unit	Allotment	Total Disburse't	1 16	2 17	3 18	4 19	5 20	6 21	7 22	8 23	9 24	10 25	11 26	12 27	13 28	14 29	15 30	31
Yellow Lumber Crayon	CS3153	P	* 24																	
Flux Lighting Powder	S95358	L	4																	
Acetylene Gas	S85370	T	5																	
Oxygen Gas	S38371	T	8																	
#2 GMO Grease	S95414	L	165																	
Stanolind	S55544	G	1269																	
#27 Quick Dry Asphalt Paint	S86568	G	1																	
White Lead	S86605	L	2376																	
Buckeye Tapping Paste	S85450	L	155																	
Washed Rags	S86681	L	* 375																	
Flint Gasket Shellac	S86711	G	38																	
SB Lubricant	S852956	L	53																	
*Based on Monthly Allotment.																				

Form 3 (left) — Oakland uses a control form by means of which disbursement of each item of non-productive material is checked every day in the stores department

Accounting Department Copy

CENTRAL STORES DISBURSEMENT REPORT

Cylinder Block & Brg. Cap - Pon.

DEPT. 960

8.8 UNITS 2nd HALF OF September

MATERIAL NAME	Catalog Number	Unit	Allotment	Total Disburse't	Unit Cost	Total Cost	Cumulative Allotted	Cumulative Amount Used	REMARKS
Yellow Lumber Crayon	CS3153	P	* 24						
Flux Lighting Powder	S85358	L	4						
Acetylene Gas	S85370	T	5						
Oxygen Gas	S38371	T	5						
#2 GMO Grease	S95414	L	165						
Stanolind	S95544	G	1269						
#27 Quick Dry Asphalt Paint	S86586	G	1						
White Lead	S86605	L	2376						
Buckeye Tapping Paste	S85450	L	155						
Washed Rags	S85681	L	* 375						
Flint Gasket Shellac	S86711	G	38						
SB Lubricant	S852954	L	53						
*Based on Monthly Allotment.									

Form 4 — A copy of Form 3, Oakland's disbursement report, is sent to the accounting department, for checking

In operation, the scheme is based on the relation of the non-productive dollar to the productive dollar. The ratio for the current period is thus comparable with the previous year and the previous quarter. Operating departments are not constrained to any definite budget, but good management demands that the ratio of the non-productive dollar to the productive dollar must decrease progressively. An unusual increase in any item will bring an investigation which may lead to a change in method or may uncover a fault. All supplies are drawn out of the main crib on requisition blanks signed by the foreman. They are immediately charged to the department and are kept in the division crib. Form 2 shows the quarterly summary which is sent to each division superintendent. This gives the superintendent a close check of the departments under his control. Each week the foreman is supplied with a sheet giving his total expenditures for the week. A monthly report gives the foreman his actual standing in percentage, as compared with figures for the previous month. In this manner the foreman is constantly on the job to keep down the level of expense in his department.

Some idea of the practical worth of this system may be gained from the following figures: In 1925, when the system first was put into effect, the ratio of non-productive to productive dollars was 66 per cent. In 1928 this ratio was 37 per cent.

Oakland's System

Another effective type of non-productive material control is in operation at the Oakland Motor Car Division of General Motors. Their control system varies from the one used at the Timken plant in several important respects. To begin with, the foreman is held down to a definite allotment on each item of supply. This allotment is based upon the average of usage during some previous period. Another difference is that disbursements of each item to each department are checked day by day in the stores department. Form 3 shows the disbursement report upon which this control is based. Each sheet covers a two weeks' period. A copy is held by central stores, the foreman and the standards office. Disbursements are noted each day, and if any allotment is exceeded before the end of the two weeks' period, the requisition is not filled by the stores department unless countersigned by the superintendent of that division. Form 4 shows the accounting department copy of the disbursement report. Here the figures are brought down on the basis of dollars and cents and are later summarized by departments and by division superintendents. A daily over-run report (Form 5) is made out by central stores and sent in to the standards department every day. This permits it to be in intimate touch with changes in material requirements. Although this control system was introduced only six months ago, there is a consistent gain in economy. An accurate check showed that in the period between July 1 and Sept. 1, 1929, the cost of non-productive materials decreased 67 cents per car.

Continental's Problem Differs

At Continental Motors Corp. the nature of the product and the layout of the plant make its problems different. The management is interested only in certain items of non-productive expense, and finds it possible to control these without any special paper work or control system. For example, one of the largest items of expense is jigs and fixtures. To control this Continental has standardized on certain definite sizes of steel stock. Only these sizes are kept in stock and used in the design of the jig or fixture. This has enabled them to cut their inventory of steel stock, and has made it a simple matter to salvage obsolete equipment. Another important development here is the adoption of suitable equipment and a new method for mounting honing stones at the plant instead of buying a completely assembled hone. This one change effected a saving of $8,500 at its Muskegon plant and $2,300 at the Detroit plant during the year 1928.

An excellent example of a complete non-productive material control is in operation at the Studebaker plant. As in some of the other systems, each department operates on a definite budget or allotment for each item of expense material. Here, however, the allotment is based upon a definite value in dollars and cents of the non-productive material for each productive dollar spent by a department. Another important variation is that all items of expense material used in the department are shown on the disbursement report (Form 6). The fore-

man is not permitted to requisition any material not shown on this list. By this simple expedient the management is enabled to control positively all non-productive materials and prevent the use of anything not specifically indicated.

Material is drawn out daily on requisitions signed by the foreman and entered on the disbursement report (Form 7). This report covers a two weeks' period, and actual requirements for each two weeks' period are made on a sliding scale, depending upon the foreman's estimate of productive expense for that period. In this scheme the foreman is held responsible for total expenditures in dollars for non-productive materials during the two weeks' period. If he overruns his allotment, the requisition must be countersigned by his superintendent.

Studebaker, too, believes in selling the idea to the foreman. This is done by supplying each foreman with a report showing expenditures for his department twice monthly. The economy they have effected through the operation of this system is really amazing. Some years ago, before the system was installed, the cost of non-productive material per car in a certain large division was $26. Now the cost per car in that same division is $6, and the indications are that even this figure will be bettered in time.

Ford Control at Stores

At the Ford plant the procedure is somewhat different. All of the control is vested in the stores department. Based on past performance, the stores department maintains a stock sufficient for 30 days' supply. The operating departments are not held down to any definite allotment or budget, but each foreman is held accountable for expenditures in his department. All supplies are drawn out on requisitions, which are turned over to the accounting department. In turn the accounting department issues a report monthly of bulk expenditures for non-productive material. A copy of this report goes to the stores department as a basis for comparison with previous months. In contradistinction to the practice in other plants, however, no report goes to the foreman.

The stores department maintains a staff of 12 specialists who are assigned to check up certain important items. These men really constitute their control system, because they follow the situation day by day and are in a position to make recommendations or changes wherever indicated.

The White Co. makes it the job of the foreman to hold down the cost of non-productive materials in his department. He is given a monthly report showing the total expense in his department and is expected to keep expenditures within certain definite limits. They find it profitable, too, to give foremen a bonus for keeping down the cost in his department. A novel feature here is the fact that their non-productive control system is built around their salvage department. All requisitions for small tools, perishable tools and all other salvageable materials are sent first to the salvage foreman, who tries to fill the requisition from his stock. Wherever possible he fills it by rebuilding or salvaging whatever he has on hand. Failing in this, he O.K.'s the requisition, which then goes to the stores department, where it is filled out of stock or requisitioned for purchase.

The plant engineering department also takes a hand in controlling these expense items. For example, a recent survey indicated the advisability of using towels instead of waste rags. A subsequent check shows a saving of at least $2,000 in one year's time by this change.

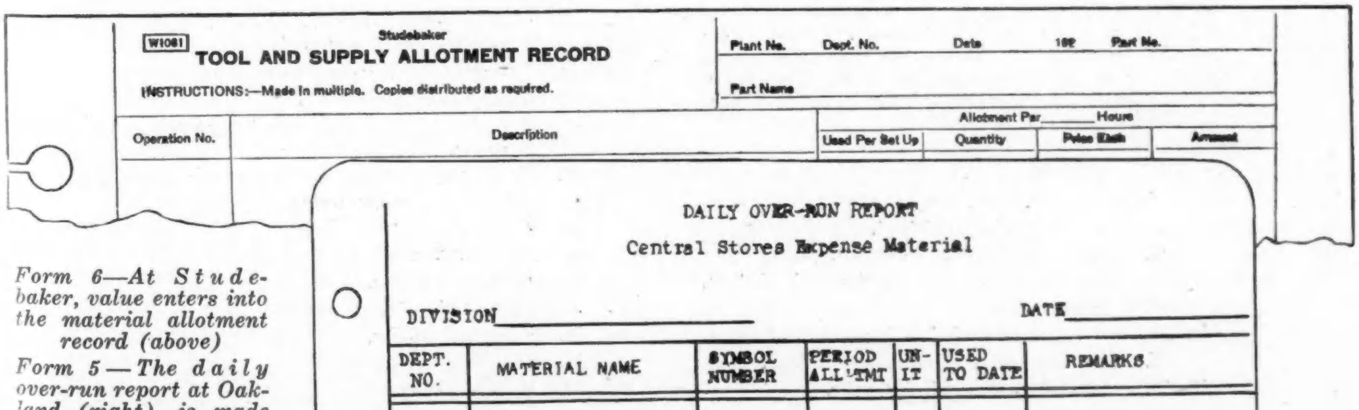
At Hupmobile the responsibility for keeping down the usage of non-productive materials is shouldered by the storekeeper and the foreman. This company has not found it advisable to keep a budget system or limit the usage of any of the non-productive materials. However, the foreman is directly responsible for holding down the expense of his department and the storekeeper must keep watch on disbursements of important items.

So far they have found it advisable to keep a detailed account of perishable tools and waste rags. As is the case in some of the other plants, the foreman is given a monthly statement of non-productive material expense in his department so as to form a basis of comparison with previous months.

Dodge Has Specialists

Dodge Brothers, too, has found it advisable to simplify its system of controlling non-productive material expense. This company employs specialists who watch each type of problem individually. These men set up standards which control the purchasing specifications, effective use and salvage of the non-productive materials that are assigned to them. Only a certain few items, such as wiping rags and perishable tools, are budgeted to the departments. Excess use of any of these materials brings an immediate inquiry.

Contrasting with the practice in these plants, and in many others, are a number of plants of large size where there is no comprehensive control of non-productive materials. For various reasons they have done little or nothing. Perhaps they have not had the opportunity to consider this seriously. The fact remains, however, that non-productive material expense can cause a serious drain and can throw a heavy burden on the overhead account. During the course of this survey the overhead expense account in one large parts plant was analyzed, and it was found that they were spending $30,000 a month for non-productive materials. A simple control system could possibly save $25,000 a year.



W1081 Studebaker
TOOL AND SUPPLY ALLOTMENT RECORD
INSTRUCTIONS:—Made in multiple. Copies distributed as required.

Plant No. Dept. No. Date 192 Part No.
Part Name

Operation No.	Description	Allotment Per ____ Hours			
		Used Per Set Up	Quantity	Price Each	Amount

DAILY OVER-RUN REPORT
Central Stores Expense Material

DIVISION ____________ DATE ____________

DEPT. NO.	MATERIAL NAME	SYMBOL NUMBER	PERIOD ALL'TMT	UN-IT	USED TO DATE	REMARKS

Form 6—At Studebaker, value enters into the material allotment record (above)
Form 5—The daily over-run report at Oakland (right), is made out by the central stores

W950 Studebaker

TOOL AND SUPPLY STORES DISBURSEMENT REPORT

INSTRUCTIONS:—Made in original departmentally by Stores Dept. from W402 bi-monthly and forwarded to Works Acct'g. Dept. which prices, extends, totals and hectographs in four copies. One copy forwarded to M.& S. Dept., Stores Dept., Dept. foreman, and one copy retained by Works Acct'g. Dept. for entry charging proper expense account and crediting Stores account.

SYMBOL UNITS AS FOLLOWS:-PIECES "A" POUND "B" FEET "C" SETS "S" GALLONS "D"

Div C Dept. No. 2

Sheet No. 1 Acct. No. 405

Month July 28 To Aug 17

Articles	Amount	Total Quan.	Sym	Unit Cost		Value	
22-T-143 Det 3	3-		A	225	00	6	75
22-T-143 Det 1	3-		A	650	00	19	50

Form 7—Requisitions of materials at Studebaker are entered daily on a special disbursement report and carry a record of costs estimated by the foreman of the department

Salvage of non-productive materials is an important adjunct to the control system. Among the more widely known salvage operations may be mentioned the following: 1. Reclaiming of kerosene used in washing operations. 2. Laundering of waste rags and towels. 3. Recutting files. 4. Reclaiming perishable tools, such as twist drills, reamers, milling cutters. 5. Chromium plating worn gages and plugs. 6. Reclaiming and redressing grinding wheels.

There are many other interesting salvage operations, however, that have been successfully developed in some automotive plants. For example, at the Dodge plant all lumber received in the form of crates, shipping blocks, and so on, is salvaged. Nails are pulled out and the pieces are cut up into standard lengths suitable for the standard shipping crates used by them. At the White Co. used tool bits are forged down to standard sized bars. These bars are cut to specified lengths and reformed into small standard tool bits. In many cases they are able to save at least $2 over the cost of a new tool bit. Another salvage operation that they have adopted has made a remarkable saving on scrap drills and reamers. Usually these small perishable tools are sold as scrap and bring between four and six cents a pound. Now they have installed a salvage grinder by means of which the low carbon shank is cut away from the high-speed steel. As a result, they sell the high-speed scrap at 20 cents a pound, making a saving of 15 to 16 cents a pound.

Ford, of course, carries out salvage operations on an extensive scale. Belting is one item which is of particular interest. In Aug., 1929, Ford salvaged 33,930 ft. The average for the year runs about 25,000 ft. a month.

Studebaker at South Bend also effects large savings by salvage operations. For example, in salvaging crates, shipping blocks and material of that description the company saves an aggregate of about 150,000 ft. per month, which is processed at a cost of $5 to $6 a 1000 ft. The cost of new lumber would easily run between $28 and $32 per 1000 ft. All belting is salvaged in the regular manner, most of the used belting being made up into double-ply belting, with salvage belting forming one layer and new belting forming the other.

A very important saving is made by repeatedly recoating abrasive disks used in Studebaker body shop. The original cost of one of these disks is 18 cents. They are able to recoat it for three cents, and can recoat on the original disk five to seven times before it wears out. Some idea of the magnitude of this saving may be gained from the fact that before the salvage operation was put into effect, the cost of abrasive disks per body was $1.25. The cost now has been cut to 25 cents a body. As proof of the thoroughness with which they

(Turn to page 538, please)

Aids to Waste Elimination

THE Division of Simplified Practice, Bureau of Standards, Department of Commerce, has issued a list of pamphlets on elimination of waste. They can be obtained by applying to the Commercial Standards Group, Bureau of Standards, Washington, D. C. Those particularly adaptable to the automotive industry are as follows:

Number	Item
6.	*Files and rasps.*
16.	*Lumber (third revision).*
17.	*Forged tools (first revision).*
20—28.	*Steel barrels and drums (second edition).*
36.	*Milling cutters.*
43—28.	*Paint and varnish brushes.*
45.	*Grinding wheels (second edition).*
47—28.	*Cut tacks and small cut nails.*
48.	*Shovels, spades and scoops.*
51—28.	*Chasers for self-opening and adjustable die heads (second edition).*
58—28.	*Classification of iron and steel scrap.*
59.	*Rotary cutters.*
59.	*Rotary-cut lumber stock for wire-bound boxes.*
60.	*Packing of carriage, machine and lag bolts.*
66.	*Automobile brake lining.*
67.	*Roller bearings.*
76.	*Ash handles.*
77.	*Hickory handles.*
89—28.	*Coated abrasive products.*
90—28.	*Hack-saw blades.*
95—28.	*Skid platforms.*
100—29.	*Welded chain.*

Just Among Ourselves

Captains of Souls Have Advantage Over Fatalists

EVERY year we grow less and less interested in panaceas, whether they be suggested for the solution of all the ills of the automotive industry in particular or of the world in general. The trouble with the panacea always is that it involves one or two conditions which could not conceivably be brought about in several lifetimes. Limitation of automobile production by general agreement is one of those conditions which we place in this class.

There are two general schools of business thought, we find; one we like to call the "man-the-football-of-fate" school, the other, the "I-am-the-captain-of-my-soul" school. The former is wont to attribute a majority of his failures and all of his ills to an overwhelming and imponderable set of facts which he calls general conditions and about which he asserts—probably truly—that he can do nothing. The latter concentrates on the reasons for his failures just long enough to be sure he thoroughly understands them; most of his time he spends, not trying to change or worry about general conditions, but to put into operation means for bettering his own position within those general conditions.

Without bothering to argue the philosophic merits of the two points of view, it has been our observation that the members of the "I-am-the-captain-of-my-soul" school are, on the average, far more successful automobile manufacturers, wholesalers and retailers than are the adherents of the "man-the-football-of-fate" group of thinkers.

* * *

Merchandising Ideas By Exclusive Contract

DESPITE the well-merited reputation of the automotive industry for being open to new ideas, any purveyor of novel or unusual automotive constructions will tell you how difficult it is to get any large manufacturer to adopt in quantity production a radically different piece of mechanism. One means of encouraging such adoption that seems to be coming into greater vogue of late is that of offering the particular construction to the first vehicle maker to adopt it as an exclusive feature for a given period of time, usually six months, a year or a year and a half.

* * *

Front-Wheel Drives Watched With Interest

NOW Gardner has announced a front-drive car for January, 1930. There can be little question but that many car manufacturers are watching with keen interest to see the engineer ing and merchandising results accruing to the front-drive cars on the American market during their first year. Whether and when there will be more constructions of this type in regular production doubtless will depend to some extent upon the pioneer experiences. In the meantime factory engineers in several places are continuing to experiment with and work on front-wheel drive experimental cars. It has begun to look as though no other manufacturers would announce such models until some time in 1930 at least.

* * *

Production is Expected To Keep Steady

RECORD setting activities are over for the year so far as automobile production is concerned in the opinion of executives of most of the important passenger car and truck companies. A majority of the chief executives who were present at the annual N.A.C.C. drawing for New York and Chicago show space last week seemed generally optimistic about the future, but pretty well convinced that no great sales or production spurts were to be expected for the industry as a whole in the next 80 days.

Questioned as to what the New Year will hold, one important sales manager voiced the opinion that it is yet too early to predict with much accuracy. The newness and attractiveness of the merchandise to be announced between now and the end of the New York show, in his opinion, will play a big part in determining the size of first quarter 1930 sales totals.

* * *

Manufacturers Are Found to be Fair Buyers

MOST parts and accessory companies supplying car and truck manufacturers seem to have profited materially this year, despite cries from some sources that the price situation has been getting no better fast. We have taken the trouble to try to run down several of these criticisms of vehicle makers' price practices, and find that very often the criticisms actually apply to one or two organizations, while praise for fair dealing and sound buying policies applies to a majority of the vehicle companies with which the vendor is doing business.

This being the case, it would seem as though those vehicle makers who gain the ill-will of a majority of the suppliers from whom they buy were likely to be harmed more in the long run from this fact than the vendors themselves, although the unfavorable results may accrue to the latter immediately and to the former only in the distant future.—N.G.S.

Material Handling Methods Schedules and *Accounting*

Control of the innumerable small standard parts incidental to the assembly of any automobile is vital to volume and closely linked with plant layout.

WHAT is the best way to handle small standard parts, such as screws, nuts, lockwashers, cotter pins, and similar materials used in large automotive plants?

Are there any short cuts that may reduce handling or record keeping and point the way to economy?

Material handling experts in prominent automotive plants have their own ideas on these moot questions. How they worked out their individual problems has been made the subject of a survey recently completed by *Automotive Industries*.

Material handling is a vital part of the production organism and is intimately linked with plant layout, nature of product, and volume. And last, but not least, it must tie in with the accounting and management program. Focused against this background, the views of these men are indeed interesting.

An outstanding example of a smoothly functioning, formal system of small parts control is found at the Highland Park plant of the Chrysler Corp. L. A. Churgay, Sr., who installed this system, described it in the June 8, 1929, issue of *Automotive Industries* in an article entitled "Flow of Parts to the Assembly Line." Some additional details given here will round out the picture.

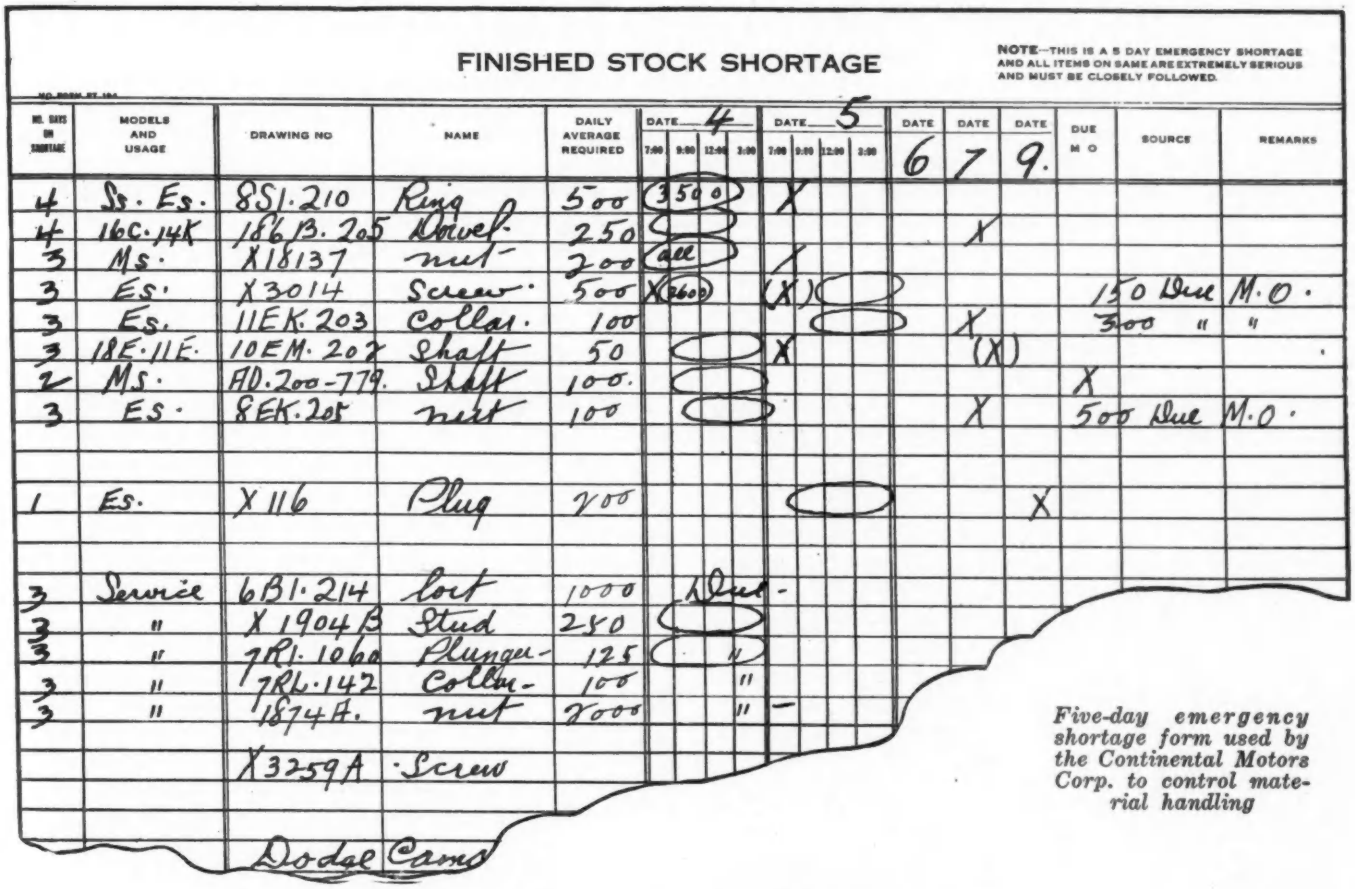
Container size is one of the first details that was studied. It had to be of convenient size, light enough when full for one man to handle, and it had to stack well on the electric shop truck.

A 12 in. by 18 in. container was finally chosen. The standard load for a truck is 20 containers and the schedule is derived directly from this capacity. The stores department carries a three-day supply of parts which is kept in the standard containers in stacks on the floor. The noteworthy angle here is this: Each container holds a definite quantity of material, and a standard bank of containers represents a known aggregate total. Consequently, this arrangement is self-inventorying and storekeepers can check their three-day minimum requirements by visual inspection.

Continental Motors Corp. just has changed its plant layout to tie up with an entirely new scheme of production and materials handling control. Central storage is eliminated. Parts and material from outside sources are scheduled closely. When received they pass through the receiving department, where they are inspected, washed if necessary, and then go directly to the point where they are used. Small standard parts required for the assembly line are inspected, marked as to destination, then placed on a floor conveyor which traverses the entire assembly line. Racks of stock bins are located at strategic points along the assembly line with

Receiving incoming materials at the Oakland Motor Car Co. plant at Pontiac, Mich.

Interwoven *With Production*



FINISHED STOCK SHORTAGE

NOTE—THIS IS A 5 DAY EMERGENCY SHORTAGE AND ALL ITEMS ON SAME ARE EXTREMELY SERIOUS AND MUST BE CLOSELY FOLLOWED.

No. Days on Shortage	Models and Usage	Drawing No	Name	Daily Average Required	Date 4 (7:00, 9:00, 12:00, 3:00)	Date 5 (7:00, 9:00, 12:00, 3:00)	Date 6	Date 7	Date 9.	Due M O	Source	Remarks
4	Ss. Es.	8S1.210	Ring	500	3500	X						
4	16C.14K	186B.205	Dowel	250				X				
3	Ms.	X18137	nut	200	all	X						
3	Es.	X3014	Screw.	500	X 2600	(X)					150 Due	M.O.
3	Es.	11EK.203	Collar.	100				X			300 "	"
3	18E.11E.	10EM.207	Shaft	50		X		(X)				
2	Ms.	AD.200-779.	Shaft	100.						X		
3	ES.	8EK.205	nut	100				X			500 Due	M.O.
1	Es.	X116	Plug	200					X			
3	Service	6B1.214	bolt	1000	Due -							
3	"	X1904B	Stud	280								
3	"	7R1.1060	Plunger-	125	"							
3	"	7RL.142	Collar-	100	"							
3	"	1874A.	nut	2000	" -							
		X3259A	Screw									
		Dodge Cams										

Five-day emergency shortage form used by the Continental Motors Corp. to control material handling

sufficient capacity to carry a thirty days' supply of these parts. As the conveyor moves along, stores men at these central points remove the material and load it into the proper bins.

A feature of this control scheme is that no paper records are kept, except in the production department where the master schedule originates. A thirty day supply is carried. This is checked visually daily by line checkers, who must not permit the stock to run down below the minimum of five days' supply. Items which run down to this danger line are immediately entered on the shortage report which is then pushed through the purchasing department for quick action. Obsolescence of parts is handled by taking them out of the assembly line bins to insure constant turnover.

E. L. Sheehy, production manager of Continental, in commenting on his reasons for installing this system said:

"As you know, losses in the shop of items of this kind are quite high and the expense of trying to maintain a record of the actual usage of material would be folly. We have saved ourselves a lot of work, eliminated shortages, avoided purchases of same each month, and a lot of other red tape by classifying these items as standard parts and setting up a set of records to be handled in a special manner from other productive material."

Dodge Bros. Division of Chrysler has a control system which is similar to this in important respects. Here, too, the control is all accomplished through the planning department. They have just two forms. One is the "Master Material Record," which shows for each part:

a—Part number, description, where used, quantity for each model.
b—Unit, i.e., lb., ft., gross, etc.
c—Normal day's supply to be carried.
d—Per cent shrinkage (allowable loss) determined by past experience.

The other form is a "Requirement and Disbursement Record" which supplements the first and shows:

a—Month by month requirement, varying with production.
b—Quantity per model. Indicates changes in this figure due to changes in design or usage.
c—Inventory records, when taken, and notes purchase releases.

This company's usual requirement of standard parts stock is 22 days' supply. When these parts are received they are routed from the receiving department directly to the point where they are used. The purchase order gives this information and the material goes right through, usually in the original shipping container. There are no central stores, nor do they attempt to place the material in bins at the assembly line. They feel that it is all quick moving and does not warrant special handling of any kind.

The stores department is held responsible for feeding the material to the assembly line. For this purpose there is a line checker in each department who keeps constant watch for shortages, replenishing where necessary. If an unexpected shortage occurs, a study is made at once to determine the reason for it. Occasionally this study uncovers a case of wrong usage or results in a change on the requirement record.

The Oakland Motor Car division of General Motors Corp. uses a very simple handling system. Here again there are no central productive material stores and all the records are kept in the planning department. Standard parts are received, inspected, and delivered to the assembly line in the original packing container. The only exception to this is in cases where more than 30 days' supply has been received at one time. In this event, surplus is kept in the emergency stores.

To avoid tying up an assembly line because of material shortage, Oakland has established an emergency stores. Here is kept a sufficient supply to take care of 5000 cars. Line checkers are employed to watch stock at the assembly lines. When a shortage occurs they draw on the emergency stores and wherever that supply is diminished a shortage record is set up which is posted on a bulletin board in the emergency stores department.

Studebaker also employs a variation of the simplified method of standard part control. This plant works on a close schedule and on standard parts at least, they carry only a six days' supply at one time. Of course, this is varied with the nature of the part and the geographical location of the vendor with respect to the plant. The vendor is required by the purchasing department to mark on each container a certain designation which indicates destination of that part at the assembly line. The materials are received, inspected and then immediately routed to their proper destination in the original containers. The stores department is held responsible for stock conditions and has line checkers watching the assembly line stock continually.

The practice at the Ford plant presents a decided contrast. They make no distinction between the small standard parts and any other unit that goes in to make up the car. Consequently, standard parts are scheduled closely and delivered daily in accordance with production requirements.

In commenting on various methods of handling standard parts, L. A. Churgay, Sr., points out, "In my experience of manufacturing I have found that the safest way to control materials is by having a definite schedule that covers the movement of every part. I am not in favor of supplying the line with more materials than it can use during any given period.

"I do not believe that the line checker is dependable and I have found that eventually the burden of watching the stock is thrown on the foreman of the department. This is decidedly objectionable, because the foreman's job is to watch the assembly line. When he takes his eyes off the assembly line something is bound to happen."

Hugh Nickerson, works manager at the Hupmobile Cleveland plant, feels that "the simplified method of controlling standard parts may reasonably be expected to show financial gain because it eliminates a considerable amount of handling and materially reduces paper work. To my mind the bad feature of this system is the psychological effect of giving the men more material than they need. This leads to carelessness with the danger of extending it to other phases of the man's work."

At the Hupmobile plants, standard parts are closely controlled and disbursed from central stores. The allotment is made on the basis of a given number of units regardless of the rate of production per day. Initial delivery of any part thus is made in a given quantity. Thereafter the bins are replenished as required. Replacements of material are watched by stock handlers and the foreman of each department.

Parts manufacturers have not found it advisable or feasible to make any distinction between the small standard parts and any other component parts. For example, at the Bendix plant in South Bend, all parts including the small standard parts are scheduled daily to the assembly line and the quantity is closely controlled.

At the Timken-Detroit Axle plant all standard parts are scheduled closely, as are other units. However, on the small standard parts they buy a three months' supply at one time and control it by means of a high and low limit established by experience for each part and recorded on cards in the central stores department.

Control of Non-Productive Materials Eliminates Waste

(*Continued from page 534*)

comb the shop for salvage material, they take the lead bushings from the used grinding wheels and melt them down to make lead hammers.

Continental Motors also finds it possible to make appreciable savings on salvage operations. One major salvage operation is that of obsolete fixtures and gages. These are turned into obsolete stores and utilized wherever possible in new production. The original design of these parts is such as to make it possible in some cases to replace or relocate bushings. In other cases the fixtures are taken apart and the steel used in making new fixtures.

The standards department is the most effective tool in controlling non-productive materials. These men have been instrumental in effecting some really remarkable economies. At the Ford plant specialists check such details as the daily cost of express shipments, and the standardization of shipping and storing containers. At Timken, and some of the other plants, the standards department tests all the non-productive material to determine conformity with specifications. At the General Motors units the standards department in each division actually carries out the entire control of the non-productive material. At Oakland a standards survey revealed about 50 trade-marked varieties of welding rod in the plant. Careful study and chemical analysis of these rods showed that only 10 varieties were necessary to take care of their needs. This has made a big difference in the inventory of this type of material.

It is evident that in a plant of any appreciable size some form of control is vital. Without it the overhead leak is large and may be growing. Yet a control can be installed readily with but little change in the existing system of accounting. A study of the clear-cut control systems described here makes that plain. A remarkable fact is that once a control system is started it gathers snowball momentum and grows into a vital economic factor in plant operation.

Machine Tool *Show and Congress Visualize Era* of Improvement

Adaptation of units to requirements of cemented tungsten carbide within a year impresses visitors at exposition in Cleveland. Production discussed at sessions.

By EARL O. EWAN

EYES of the industrial production world were centered last week on the Second National Machine Tool Builders' Exposition held in Cleveland's Public Auditorium and Annex. What the 20,000 representatives of this large economic group thought of the $5,000,000 display generally was expressed in their comments, speeches and discussions at sessions of the Second Machine Tool Congress held in the Hotel Cleveland each evening after the show had closed.

Sessions held on Monday and Tuesday evenings were under the auspices of the Machine Shop Practice Division of the American Society of Mechanical Engineers, which directed the congress. Those held on Wednesday and Thursday evenings were sponsored by the Production Committee of the Society of Automotive Engineers, and the joint production dinner given Friday evening at the close of the exhibition and congress was served under the combined patronage of the Society of Automotive Engineers, the Machine Tool Congress and the American Society of Mechanical Engineers.

Interest aroused by the exhibits evoked remarks daily as thousands of visitors jostled in the wide isles of the exposition, which was laid out on 150,000 sq. ft. of floor space. Booth attendants will vouch for the statement that the crowds were not composed of sight-seers, for they were kept on the *qui vive* almost constantly answering questions, explaining designs and operations and actually solving or suggesting concrete solutions for the problems of production men who accepted the hospitality extended at the stalls.

As many of the production men said, the exposition was an animated picture of the progress made in the machine tool industry since the first show, which was held in the same buildings in 1927. The show this year not only was larger, covering 40,000 sq. ft. more of floor space than that of 1927 and having 270 exhibitors as compared with the 185 listed two years ago, but the units exhibited indicated more clearly than commonly had been recognized the rapid advances that have been made in machine tool designing and construction within the last 24 months.

Henry Buker, vice-president, Brown & Sharpe, and president, National Machine Tool Builders' Association, under whose auspices the show was held last week

An even shorter period of time, only about 12 months, has been available for the machine tool industry to endeavor to accommodate itself to developments in cemented tungsten carbide. Yet the tangible proofs of accomplishments in this connection were such as to evoke probably the most comment of any subject inspired by the show. In doing this, manufacturers of tools had to meet successfully such requirements as greater spindle speeds, which in turn necessitated alterations in bearings and increased stiffness of construction to insure rigidity.

One of the highest tributes paid the machine tool industry in this regard was expressed at the second session of the congress by the chief speaker, Dr. Zay Jeffries, consulting engineer of the General Electric Co., of Cleveland, and president of the American Society for Steel Treating. In the course of his discussion of "The Present Status of Cemented Tungsten Carbide," he said:

"Broadly speaking, about one year ago the whole country became conscious that there was such a material as cemented tungsten carbide. Naturally, the machine tool builders had to make some tests of their own to warrant their own expenditures in developing machines to better fit the properties of cemented tungsten carbide, and I think it is paying them a great tribute to see what they have accomplished in this short time as reflected in the exposition at the Public Auditorium."

Dr. Jeffries did not stop with that, however, but predicted that if the next exposition under the auspices of the National Machine Tool Builders' Association is not held until 1932, visitors at that show "will see a revotionary change in machine tools."

Speaking at the production forum held Thursday evening, E. P. Blanchard, chairman of the Production Committee of the Society of Auto-

motive Engineers, said that the machine tools on the floor of the Public Auditorium and Annex were "up to the minute" in the way of developments to utilize cemented tungsten carbide in the applications concerning which there now is positive information.

Other speakers at the same session pointed out that machine tool builders were exhibiting and building units to meet the growing requirements for hydraulic feeds, automatic clamping, handling and operation, as well as automatic and one-shot lubrication. The fact that tool makers now are confronted with the question as to where to limit the number of operations that can be performed by one machine in order not to make it too complex and specialized also was brought out at that session.

Just how specifically the machine tool buyer should be told of these improvements and their operation was discussed Monday evening at the opening session of the topic following the reading of a paper on "What Information Does the Machine Tool Buyer Need From the Machine Tool Salesman?" The paper was prepared by George T. Trundle, Jr., president of the Trundle Engineering Co., of Cleveland, and read by C. O. Malpas, vice-president of the same company, because Mr. Trundle was unable to be present. It was brought out in the discussion that detailed information and not generalities is sought by prospective purchasers of machine tools regardless of whether the units are handled through salesmen representing the manufacturer or salesmen associated with an agent who deals in a complete line of machine tools, together with a variety of labor-saving devices.

From the theoretical standpoint, the subject of the congress which stirred the deepest interest, and which probably will be studied by production executives and engineers for several days and even weeks to come, was the paper on "Manufacturing Control Through Economic Size of Production Lots," which was read before the session Wednesday evening by Fairfield E. Raymond, assistant professor of industrial research, department of economics, Massachusetts Institute of Technology.

Ernest F. Du Brul, general manager, National Machine Tool Builders' Association, who directed the Machine Tool Show

He presented formulas with which to determine the size of lot that can be manufactured most economically, and which will show when the change should be made to continuous production. Such factors as cost for the space for finished stores and return on the investment in finished parts were considered in the paper. Instead of being absolute quantities, the lots indicated are designated in the form of economic ranges that are practicable until there is a marked change in sales or other conditions. The most economic type of handling equipment to use also can be determined by application of the formulas.

E. P. Blanchard, chairman of the Production Committee, S.A.E., who presided at the third session of the congress and at the production dinner, held in conjunction with the National Machine Tool Exposition

Both the gatherings at the sessions and the crowds at the exposition were international in character. Among those who registered were visitors from China, Japan, Germany, Holland, Poland, England, Russia, South America, Austria and Canada. Amtorg, the Autotrust and other official agencies of Soviet Russia were represented. Delegations from throughout the United States representing domestic concerns numbered as many as 80 in one party.

Representatives of companies engaged in manufacturing automobiles or designing and fabricating supplies for that industry composed the majority of those who registered, just as machine tools that readily are adaptable to automotive manufacturing predominated at the exposition. It was the automotive industry, in most instances, that was credited with having stimulated the machine tool industry in its work of increasing the speed of machines in order to step up production.

Influences of the greater speed factor were seen almost universally among the 900 larger machines displayed, to say nothing of the thousands of smaller units and appliances. Most of the machines were self-operating, housing their own powerplants. Their operation consumed 3,357,000 watts of electricity an hour, or 4500 hp., which was said to be a greater amount by 25 per cent than that consumed by any other industrial show ever set up in America. The exhibition also was credited with being the heaviest in tonnage of any ever held in the United States. The machines exhibited ranged in weight from a few pounds up to 40 tons each.

At the production dinner Friday evening, which marked the end of the Congress and Exposition, E. P. Blanchard was toastmaster and James Schermerhorn, Sr., of Detroit, was the principal speaker. Mr. Blanchard announced at the Production Dinner the nomination of John Younger, professor of industrial engineering at Ohio State University, to succeed him as chairman of the Production Committee of the Society of Automotive Engineers. Under the new rules of the organization Mr. Younger will be ex-officio a vice-president of the society.

Although definite figures are not available on the volume of business transacted at the show in the way of machine tool sales, it generally was estimated that the amounts involved aggregated a sum in excess of any ever realized at a similar exposition.

Economic Size of Production Lots May be Determined *by Formulae*

Application of mathematical analysis to manufacturing control is explained to S. A. E. by Prof. Fairfield E. Raymond, of the Massachusetts Institute of Technology.

"MANUFACTURING Control Through Economic Size of Production Lots" was the subject of a paper presented by Fairfield E. Raymond, assistant professor of Industrial Research, Department of Economics, Massachusetts Institute of Technology, at the third session of the Machine Tool Congress held in Cleveland last week. The session was under the auspices of the production committee of the Society of Automotive Engineers.

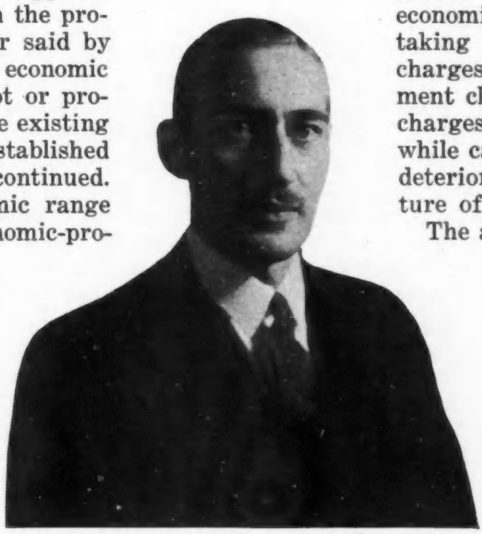
Production of parts in lots, intermittently rather than continuously, was the underlying topic discussed. Considerable research into manufacturing methods had convinced the author that certain operations in the field of automotive production definitely lend themselves to manufacturing in lot quantities and that the determination of the size of each lot by means of formulae and the method he has developed will result in important economies.

Prof. Raymond showed further that his is a reversible procedure, application of which may show that certain operations now intermittent can be made continuous profitably, even though the manufacturing equipment for the present must remain idle during certain periods.

"Economic-production quantities and certain of their contributing factors may be considered as measures which will lead to lower-cost production and the conservation of capital, when properly applied, without any undesirable increase in the production control cost," the professor said by way of definition. "A fairly broad economic range, within which any size or lot or production quantity selected to meet the existing demand will be suitable, can be established through the policy proposed," he continued.

"The lower limit of the economic range will be found to be the economic-production quantity, because the production quantity in that case is the smallest within the range and requires the least working capital of all for its manufacture. Any quantity outside of this range cannot be produced to the same manufacturing advantage—that is, with regard to the ultimate gross profit—as those quantities that lie within the range."

Prof. Raymond then defines an intermittent process as one in which the manufacturing equipment, for either fabrication or assembly of a unit of production, must be set up at intervals for the processing of any given lot of articles, because these units can be produced faster than they can be consumed.



Prof. Fairfield E. Raymond of the Massachusetts Institute of Technology, whose formulae for determining the size of production lots were features of the first S.A.E. meetings at the Machine Tool Congress held in Cleveland last week

"An economic balance must exist between the total preparation cost for each lot and the total investment charges incurred by the storage of the articles thus produced while awaiting eventual consumption on future orders to assure the minimum-cost quantity. Accordingly, the best quantity to produce will be that for which a unit allotment of the preparation cost to each article will be equal to the unit storage investment charge, because only at this point does the ultimate unit cost become the minimum. From this, a simple definition for the minimum-cost quantity can be derived, and the quantity determined.

"In addition to the desire for the conservation of capital, manufacturers of automobiles are confronted by the problem of obsolescence due to style change and design improvements. Both conservation of capital and protection against losses from obsolescence can be achieved through the production at any one time of the smallest number of units that is permissible within the economic range. This quantity obviously will be smaller than the minimum-cost quantity. Combining all these factors, an economic-production quantity may be defined as that quantity which can be produced at the lowest total unit cost consistent with an economic use of capital in its manufacture, taking into consideration the preparation charges against each process order, investment charges on the capital involved, rental charges on the space occupied by the article while carried in stock, possible losses due to deterioration and obsolescence, and the nature of the process."

The author then showed that evidently the larger or minimum-cost quantity and the smaller or economic-production quantity must be respectively the upper and lower limits of the economic range, which thus becomes established. Moreover, once these limits are established for each process which lends itself to intermittent production, they can be set up in the production department as a guide in controlling manufacturing schedules.

To show where this method may be applied in the automotive field, Prof. Raymond pointed to the following examples of intermittent production:

1. Scheduling of work for automatic machines, because their initial set-up is costly and their rate of production may exceed eventual sales demand.
2. Forging operations.
3. Pressed metal parts, such as fenders, radiator shells, body panels, etc.
4. Automobile hardware of seasonal or style type.
5. Automobile accessories.
6. Replacement parts.

Economic-production quantities should find wide application in certain specialized branches of the automotive field, such as the motor truck, tractor and others whose output is varied as to models, and the number of units produced is so much smaller than in passenger car manufacture.

Assistance to Engineers

"Aside from the advantages gained through the control of production," said the professor, "the principles underlying the economic-production quantity can be of considerable assistance to process engineers in their analysis of manufacturing operations.

"If there is a choice of several methods of manufacture, the economic quantities and the proposed unit costs for all may be determined and compared, in order to select that process which will ultimately yield the lowest unit cost for production. Expensive tools, jigs and fixtures that might yield remarkably low costs in large-volume production might not earn their cost, if applied to manufacturing the same articles at their current rate of consumption, before the utility of the article is changed because of design obsolescence. Therefore a less highly refined process may be most economical for a lot of moderate size.

"Choice of machines can be made best with a knowledge of the most economical quantity that can be produced upon those machines; and their adoption may be justified, even though they may at times be idle, provided the size of the manufacturing lot is sufficient. The space allotted to the manufacture of any article depends upon the type of equipment employed as well as the quantity that is to be placed beside each machine during its operation; therefore, the lay-out of the process also depends upon the economic quantity.

"Selection of material-handling equipment often depends upon the number of articles to be moved in any one time, as well as the nature of the article. The size of the lot will then determine the most economical size of the container or may indicate that conveyors should be provided."

Limits of Economic Range

Determination of the limits of the economic range can be accomplished by substituting indicated data in the general formulae. Equation I is for Qe, the economic quantity; and Equation II is for Qm, the minimum cost quantity. The symbols are explained under the formulae on page 543.

"In actual practice, both of these expressions should be simplified to suit the conditions pertaining to the specific industry or product before any attempt is made to introduce the data for a given problem," Prof. Raymond explained. "The denominator of each equation is composed of the sum of three groups of terms. These groups may be designated as elements, of which the first accounts for the influence of the investment charge on articles in stores, the second for the influence of the investment charge on work in process, and the third for the influence of the space charges incurred by articles in stores.

"As a result of an extended amount of research into the application of the general formulas to specific cases in industry, it has been found that accurate figures for the limits generally can be obtained by using only the one of these elements which has the greatest influence upon the problem; only in exceptional cases will two elements be required.

"The second element of the formula, depending upon the investment charges for work in process, will be found to control the situation in many cases in the automotive industry, where finished parts or assembled stores have been dispensed with. The third element, depending upon the space occupied by articles in stores, will be the controlling factor less frequently.

"A distinction that must be borne in mind is the difference between the interest rate i and the expected normal rate of return from capital employed in production r, when used in conjunction as a corrective factor for the conservation of such capital in the determination of an economic quantity and when the interest rate i is used alone for computing the cost of the capital employed, in determining the minimum-cost quantity. This suggests an extended controversy, long extant among accountants, over the use of interest as an item of cost. In reality, this difference in viewpoint is of little consequence in this connection, as the economic balance demands recognition at least of the existence of the investment charges on inventories but is in no way concerned over the accounting problems involved.

Combined Values Symbolized

"Executives need not be disturbed over the fact that private information of a corporate nature has to be employed in order to realize the advantages that can be gained through the application of economic quantities, because a single figure which will represent the combined values for the interest rate and the expected return on capital can be established by these executives, and this figure can be used as the desired corrective factor without divulging either item. This is true especially in cases, most common in the automotive industry, in which the large central parenthesis in the denominator of (1) is equal to $(1 + r/i)^2$. The economic-production quantity, in such a case, can be reduced to $Qe = \sqrt{(PS/c)}$, when $i = 6$ per cent and $r = 18\frac{1}{4}$ per cent."

The author then goes into detail in explaining various methods employed to simplify equations (1) and (2) depending upon determining factors. He has also prepared a graph showing corrections for variation in the rate of consumption; and another graph showing savings resulting from manufacturing economic-production quantities.

Prof. Raymond feels that the general adoption of economic lot sizes has been delayed because of fallacies which have arisen in the interpretation of the data involved.

"The most serious has been the use of the rate of production in determining the proportion of any lot which can be diverted directly from the process to current sales orders," the professor said. "Instead, the rate of delivery to stores, D in the equation, should be used. It can be readily realized that the rate at which articles are delivered to stores will be much more rapid than the rate of production for the whole process, except in the case of a process that is composed of only one operation.

"Another error that has arisen from the same source is the use of the production rate as a measure of the total production time upon which the investment charges for work in process are determined. In few cases is the production rate for the whole process known, where-

Equation I—Formula for the Economic Production Quantity, Q_e

$$Q_e = \sqrt{\frac{P \cdot S}{\left\{\frac{c}{2}\left[1-\frac{S}{D}\left(1-\frac{1}{n}\right)\right]+\frac{m+c}{2}\cdot S \cdot t\right\}\left\{i+2r+\cfrac{r^2}{i+\cfrac{2s \cdot v}{h\left[c+\cfrac{(m+c)\cdot t}{\frac{1}{S}-\frac{1}{D}\left(1-\frac{1}{n}\right)}\right]}}\right\}+\frac{s \cdot v}{h}\left[1-\frac{S}{D}\left(1-\frac{1}{n}\right)\right]}} \quad (1)$$

Equation II—Formula for the Minimum-Cost Quantity, Q_m

$$Q_m = \sqrt{\frac{P \cdot S}{\frac{c \cdot i}{2}\left[1-\frac{S}{D}\left(1-\frac{1}{n}\right)\right]+\frac{m+c}{2}\cdot S \cdot t \cdot 1+\frac{s \cdot v}{h}\left[1-\frac{S}{D}\left(1-\frac{1}{n}\right)\right]}}$$

Note that these are basic formulae. In every specific case they resolve into simplified forms, one of which appears in the latter part of this paper.

Definitions of Symbols

c = Unit production cost, in dollars per piece.
D = Rate of delivery to stores, in pieces per year.
h = Average height to which storage is permitted in finished parts stores, in feet.
i = Interest rate, in percentage per year.
m = Unit material cost, in dollars per piece.
n = Number of batches per lot.
P = Preparation cost, in dollars per lot. This item includes total labor and overhead charges involved in setting up the machines.
r = Expected rate of return on capital employed, in percentage per year.
S = Consumption rate, in pieces per year.
s = Space charge per year, in dollars per square foot.
t = Unit production time, in days. The time consumed to perform each operation is determined for one piece.
v = Unit storage space required, in cubic feet per piece.

For brevity, the interpretation of each quantity is omitted. The author defines each symbol completely.

as the unit production time for any piece can be found in the cost records or production records, if time studies have been made and wage rates set. Obviously it will be much more convenient to obtain the sum of these unit-production times for each operation and use this as the total unit time for the production of each piece, rather than to try to compute the total production rate and derive a time factor from that.

"Another cause of unnecessarily large errors in the economic quantity is the widely divergent definitions for prime cost. The term has been avoided in this discussion for this reason.

"Further criticism of the economic size of manufacturing lots has arisen from industries in which methods of forecasting the sales demand have not become refined as highly as in the automotive industry.

"The original purpose of these executives is to be conservative by keeping down inventory values, but the smaller valuation for inventory purposes serves to increase considerably the quantity that the economic theory of production seems to allow, and consequently makes actual inventory values greater than they would be if overhead had been included in the unit-production cost."

The savings that can be realized by the adoption of a policy of employing economic production quantities are determinable by reference to a graph showing savings resulting from manufacturing economic production quantities.

"Any quantity lying within the economic range should preferably be used as a basis for production and inventory control, because it will yield a greater gross return upon the capital employed in manufacturing operations than any figure outside the range, even though the increase in cost for the outside quantity may be apparently less," said Prof. Raymond.

"This method of determining the ultimate savings may well be followed by the process engineers as a part of their initial test prior to the adoption of a production quantity. This procedure requires the calculation of the minimum-cost quantity, which is not unreasonable, as some measure or standard is necessary.

"Many cases may be found in the automotive industry in which no material saving would result from the adoption of an economic-production quantity. This does not mean that the theory of economic-production quantities is at fault, but that the automotive industry is far in advance of many other industries in its adoption of improved manufacturing methods," Prof. Raymond concluded.

Automotive Influence Evident at

Cleveland show, held last week, had variety of equipment especially production with increased

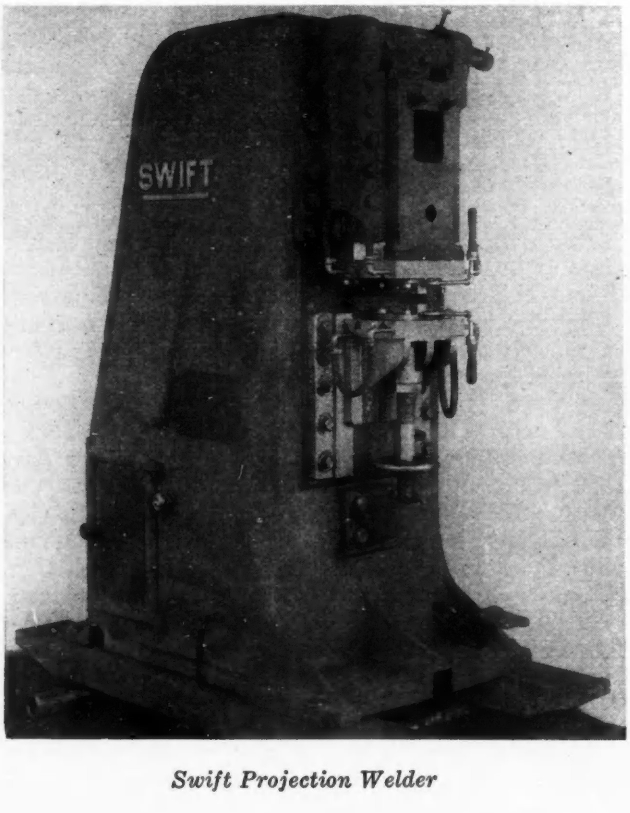
AUTOMOTIVE production men found an era of new developments and significant improvements in machine tools unfolded at the Second National Machine Tool Builders' Exposition held last week at Cleveland in the Public Auditorium and Annex.

The first exposition was held in 1927. It housed the displays of 180 exhibitors while that of 1929 accommodated the products of 270 exhibitors.

Descriptions of a number of the new developments in machines and attachments appeared in the Sept. 21 issue of *Automotive Industries*. Another group, which was not ready until the opening day of the show, is described in this article.

Several entirely new types of machines have been made available. Other machines were shown in new sizes, thus permitting a better selection which is more consistent with quantity requirements. The influence exerted by automotive requirements was reflected in equipment designed especially for mass production with accuracy and an increasing variety of full automatic operations. The ingenuity, painstaking care and huge investment embodied in these new machine tools show in a concrete way that the machine tool builders are all geared up to boost automotive production to new levels of output, coupled with still better standards of quality and economy.

Improvements in design, in construction, and in operation were in evidence to a remarkable degree. Hydraulic mechanisms were numerous. Not just a tendency, but an intelligent application of this medium, wherever it is of real value, was seen. Several machines have been made full automatic by hydraulic mechanisms. Others employ this method to control feed, table movement, or to operate chucks.



Swift Projection Welder

Several basic reasons for the use of hydraulic devices were given, including the flexibility of this medium and its adaptability to simple automatic control and the possibility of making the entire machine self-contained with a built-in hydraulic system, thus making it independent of outside sources of energy.

The influence of the new alloy cutting tools, particularly those made of cemented tungsten carbide, was plainly evident. Machine tool builders have recognized this new medium and have had the courage to pioneer costly changes in their machines to accommodate it. Accordingly, many machines are now capable of high spindle speeds if desired. This has been accomplished by changes in gearing and motor sizes. The requirement of rigidity due to the higher speeds and greater loads has been met by increasing the size of parts, stiffening the beds, ways and tables.

Automatic lubrication was a feature of many machines. Others had a combination of force feed and magazine feed. One shot lubrication and high pressure magazine oiling, such as are found on automobiles, also were in evidence. Many machines were equipped with oil filters to protect the lubricating system. The use of more complete enclosures for moving parts was also noticeable.

The practical production man who came down to learn about the new things and to get a practical solution to his problems found help at the show. Every machine was moving and demonstrating its ability to handle some difficult job. Here was a machine showing what it could do with cemented tungsten carbide. It was removing a 1½-in. chip from a steel bar turning at a speed of 606 ft. per min. with 0.010-in. feed. On a cast iron bar turning at 1250 ft. per min., it removed a ¼-in. chip with 0.145-in. feed. All this was done dry. Tool grinders showed their ability to grind and true-up cemented tungsten carbide tool bits.

Then, there were the new improvements in attachments, chucks, collets and small tools. Several exhibits showed the latest developments in the art of gaging and inspecting tools and finished parts.

Swift Projection Welder

THE No. 16 projection welder is a new production multiple spot welder just announced by the Swift Electric Welder Company, Detroit, Mich. The welder

National Machine Tool Exposition

270 exhibitors, who displayed a great designed for accuracy in mass automatic features.

is operated by means of a foot pedal and clutch, allowing one cycle or continuous operation. By using properly shaped points the machine may be used as a heavy duty spot welder, for welding sheet metal, angle iron or other stock within the capacity of the machine and adaptable to spot welding.

The automatic pressure device permits a high rate of production and insures sufficient pressure to complete entirely satisfactory welds. The machine bed or frame is built of semi-steel. The motor and other working parts are fully enclosed within the housing of the machine; these are easily accessible, however, for oiling and maintenance. Wherever possible, unit design and construction is used.

The die blocks, secondary coils, upper head and table are water-cooled. The primary coils are Bakelite treated and air-cooled. A six-point regulator switch, tapped to the coils, regulates the amount of heat for welding various sizes of stock within the capacity of the machine. One set of Elkonite-faced flat dies is furnished as equipment.

Four-Spindle Rougher

THIS machine, built for rough cutting straight bevel gears in large quantities, has been introduced by the Gleason Works, Rochester, N. Y. It is designed primarily for gears of the sizes ordinarily used in the differentials of automobiles, and is completely automatic in operation, including loading and unloading.

The entire machine, with the exception of the cutter drive, is hydraulically operated. Four blanks can be cut simultaneously. These are mounted on four independent work heads arranged around the cutting tool, a disk milling cutter 20.8 in. in diameter having 32 inserted blades.

In the operation of the machine each work head is fed into the cutter to cut a tooth slot in the blank and is then moved away to permit indexing. After all the teeth are cut, the work head backs away from the cutter approximately 5 inches to the loading position, the cut gear is automatically pushed off the arbor. A new blank is now taken from the magazine by an automatic loading mechanism, placed on the arbor and clamped in position. The head then returns to operating position and the cutting and the indexing cycle commences on the new blank. An automatic safety control prevents the feed movement from starting in case the blank is not properly placed.

The time of movement of the work head to loading position is governed by an adjustable control device which can be set for gears of any number of teeth up to thirty.

The loading operation is controlled from a series of valves cut into a single drum so that it is impossible for the various operations to get out of time with each other. The work heads are entirely independent of each other.

Placement and removal of the cutter is effected by a crane and chain hoist. A substantial supporting bracket is bolted to the central column and supports the crane standard and cutting oil feed pipe. A swivel valve joint is embodied in the arm carrying the cutter guard, inside of which are housed the four supply pipes that convey the coolant to the cutter at the cutting positions. When the cutter guard is swung up, the cutting oil is shut off.

Chip deflectors attached to the saddle housing direct the chips to the skirt surrounding the cutter. The completed gears, oil, and chips slide down a chute into a pan where they are separated.

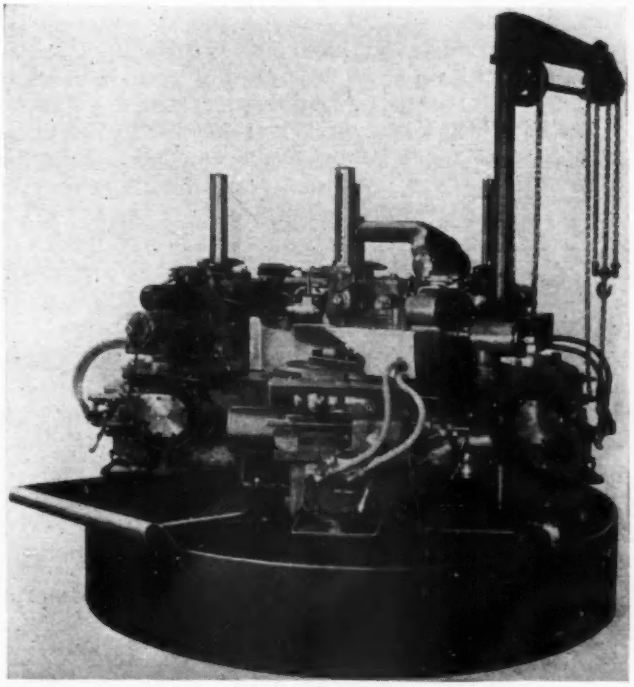
Loading of the magazine is facilitated by the use of a loading bar on which the blanks are assembled. This bar is inserted with the blanks locked on it at the top of the magazine, and by releasing a clamp screw the gears are dropped into the magazine.

Capacity of machine up to 3 in. D. P. Drive is taken from built-in 10 hp. motor. Floor space required, 85 in x 103 in.

Sebastian Lathe

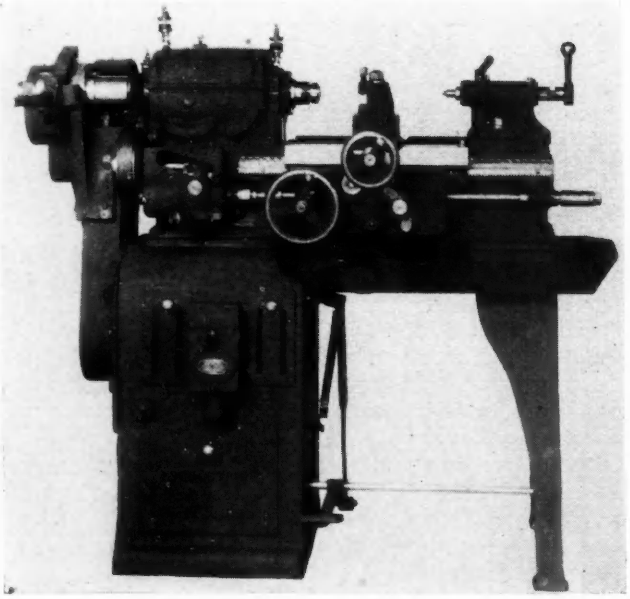
A NEW single-purpose turning lathe has been placed on the market by the Sebastian Lathe Co., Cincinnati, Ohio.

This lathe is equipped with positive stops for length



Gleason Four-Spindle Rougher

and diameter of work. Additional features are the quick-acting tail stock and quick-acting draw chuck. For flexibility of operation this machine provides four



Sebastian Turning Lathe

feeds and four speeds. Spindle speed is 1200 r.p.m. Capacity is indicated by an 11-in. swing and 3-ft. bed.

New Cincinnati Shapers

TWO new Cincinnati Shapers are announced by the Cincinnati Shaper Company, Cincinnati, Ohio. One is a 24-in. Heavy Duty Shaper, the other a 16-in. Heavy Duty Shaper. Both machines have a built-in power rapid traverse.

The 16-in. Shaper is equipped with the Cincinnati Universal Table which is a revolving table with a tilting top, without hinges, jacks or table support. Cutting speeds have been increased, giving it the highest number of strokes per minute of any Shaper ever built by this company. A new combination tool tray and cross rail guard was shown on this Shaper. Timken thrust bearings on each end of the cross feed screw have replaced the usual bearing method and make the table easy to hand feed.

Another feature of the Shaper is the construction of the ram bearings, which now extend to the end of the ram and reduce overhang from the cutting tool to the ram bearing by $2\frac{5}{8}$ in.

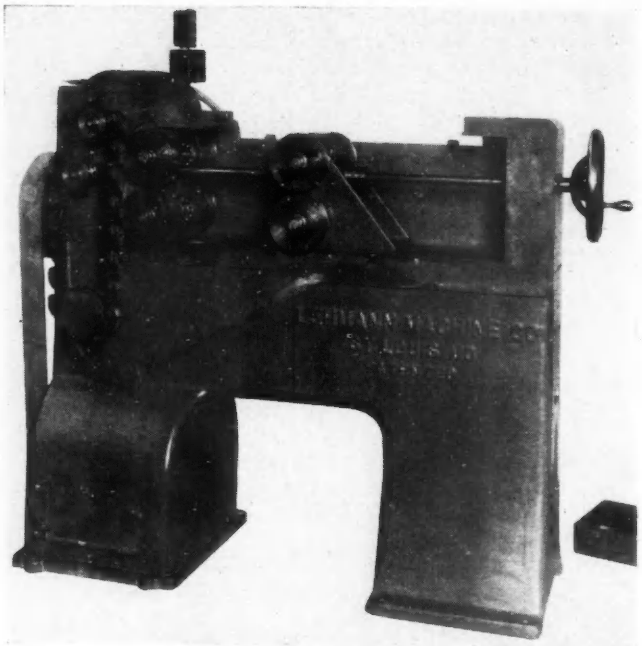
Cincinnati Heavy-Duty Shaper

These new features are also built into the 24 in. Heavy Duty Shaper.

Gear Lapping Machine

A NEW gear lapping machine has been added to the line of the Lehmann Machine Company, St. Louis, Mo. This gear lapping machine is a simple, effective machine for lapping the teeth of gears, especially hardened gears, to the shape necessary for smooth running qualities. Its functions are based on corrective abrasion governed by the restraining movements of round disks under pressure contact.

It consists primarily of two spindles, upon the outer ends of which the mating gears to be lapped are secured. These spindles carry hardened friction rolls of the exact pitch diameter of the gears being lapped and are driven by contact with rolls on the driving spindles of the machine. Two of these driving spindles are journaled in a head which is adjustable so as to bring the gear carrying spindles together until their hardened rolls are under pressure contact and the position of the mating gears is limited to the correct center distance. The pressure on the disks, necessary for the desired effect, reacts on eight large ball bearings in which the friction rolls are journaled. Oil



Lehmann Gear Lapping Machine

and abrasive are fed on the gears being lapped and while the gears govern the general relative movement, the disks resist any departure from the normal.

Absolute exactness in the diameter of the disks is always lacking to a sufficient degree to cause a slight departure from their correct relative movements. This difference results in a continuous pressure on one side of the gear teeth, at first effective only on irregularities which project beyond the correct tooth curves. A reversal in the direction of rotation brings the other sides of the teeth in contact with the same results.

No change in pitch diameters occurs, as the corrective abrasion only thins the teeth by the extent of the projecting irregularities.

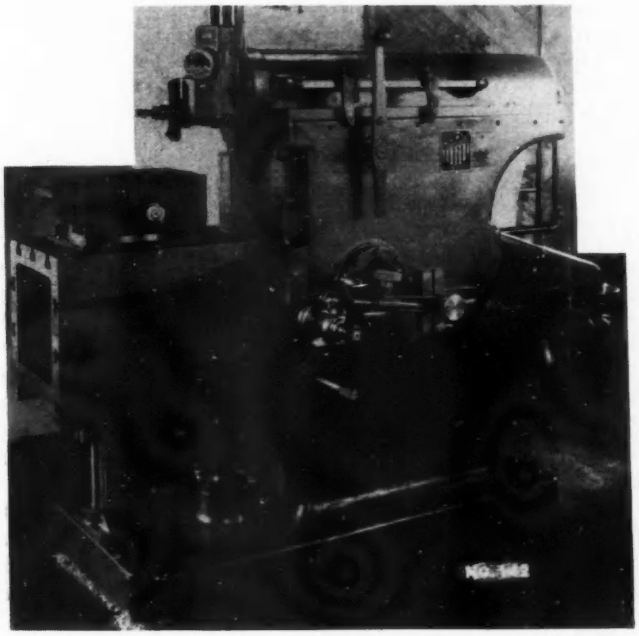
Gears with hunting teeth more readily and effectively compromise with the restraining movement of the disks because of the greater distribution of transferred error. Where gears have numbers of teeth with com-

mon multiples, any considerable error in tooth form would necessitate several different meshings of the gears for properly effective results. A few minutes running usually suffices to get the desirable smoothness of action. The gears are quickly put on and removed and one operator can take care of several machines.

The motor installation recommended is 3 hp. at 1800 r.p.m.

Hydraulic Shaper

A NEW 18-in. Hydraulic Shaper is announced by the American Broach & Machine Co., Ann Arbor, Mich. This shaper embodies important features among



American Broach & Machine Co.'s Shaper

which are: Powerful cutting strokes, controllable variable speed, and stroke cut-off at any point.

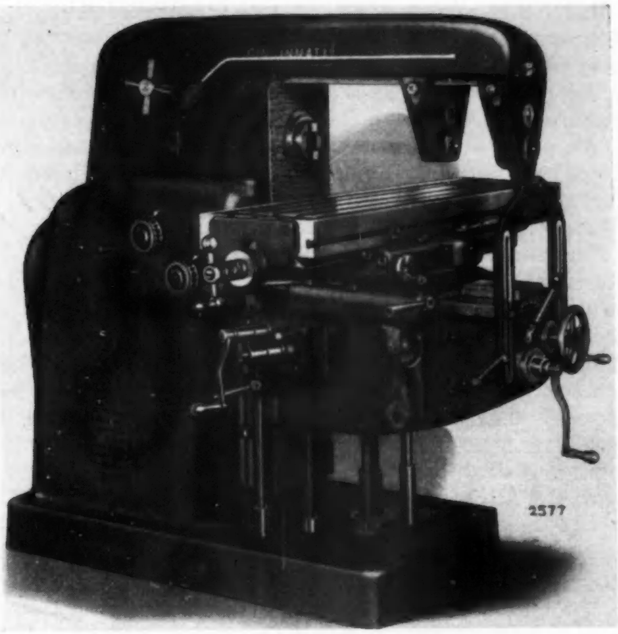
For ease of operation, the speed control lever is placed conveniently within the reach of the operator. If he finds it necessary to cut off the stroke and return the tool, he can do so by pushing the dog lever which is within easy reach.

Individual motor drive is recommended, specifications being 1200 r.p.m., 5 hp.

Cincinnati Millers

THE new No. 3 Cincinnati knee and column type milling machines were introduced by the Cincinnati Milling Machine Co., Cincinnati, Ohio. These are being marketed in the plain, universal and vertical, belt or enclosed chain motor drive. They are designed to meet the requirements of toolmakers and operators in the manufacturing shop.

Operating convenience is accomplished by providing an automatic power shift for the spindle speeds as well as the table feeds, controllable from either the front or the rear of the machine. By conveniently locating the speed and feed-changing lever and removing the manual effort from speed and feed changing, operators will be more likely to change the feed and speed demanded by the cut, resulting in greater production and a higher quality of the milled surface. There are sixteen speeds and sixteen feeds available. A pump,



Cincinnati knee and column miller

located in the knee, automatically lubricates the knee while the saddle and table are lubricated by what is known as the one-shot oil system located at the left end of the saddle. A few turns of the crank forces oil under pressure to all the bearing surfaces.

There are no universal joints and the vertical driveshaft is enclosed which adds to the safety of the operator. The leadscrew construction has been improved. The screw itself is larger in diameter, has a long bearing in the leadscrew nut, and in addition the ends are mounted on a single mounting of roller bearings which takes up both the radial and end thrusts. It is thoroughly lubricated by the one-shot system which lubricates the table ways.

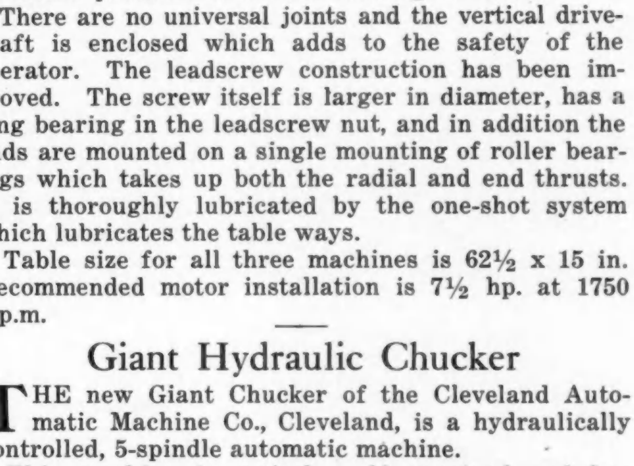
Table size for all three machines is 62½ x 15 in. Recommended motor installation is 7½ hp. at 1750 r.p.m.

Giant Hydraulic Chucker

THE new Giant Chucker of the Cleveland Automatic Machine Co., Cleveland, is a hydraulically controlled, 5-spindle automatic machine.

This machine is entirely self-contained and has readily accessible parts. All the work of tooling the machine can be performed by an operator standing in front of the machine.

The barrel type of tool turret, following the conventional design of Cleveland Model A and M machines, moves back and forth in the wide bearings on the tool turret housing and is kept in alignment by



Cleveland Giant Chucker

a large key anchored in the tool turret housing, which fits into a spline cut lengthwise in the periphery of the tool turret.

Positive grip on tools is assured by double clamping bushings, one on each side of the turret holes.

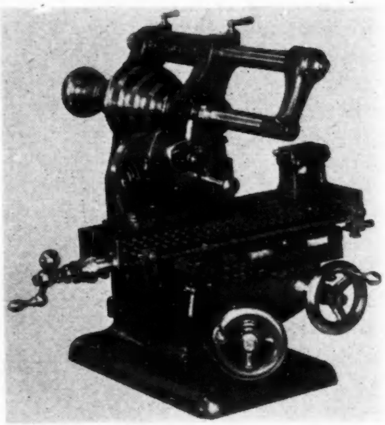
An extra attachment to the tool turret has been provided, in addition to the usual assembly, permitting tool combinations that would otherwise be complicated if carried out in one tool design.

Tool sequence of the standard machine provides for standard tools in the Nos. 1 and 2 positions that advance with the turret at the same feed per revolution. In Nos. 3 and 4 positions (upper rear and top) the tools are clamped in independent revolving spindles, moving longitudinally in the tool turret, but individually controlled by levers, actuated from a drum and cams, mounted on the upper camshaft.

The hydraulic unit consists of a high-pressure variable delivery pump, a low-pressure gear pump, a stroke control lever, a pressure-changing mechanism and a built-in control valve, all contained in a single unit and mounted in the oil supply reservoir, located at the right-hand rear end of the machine and driven at constant speed by a silent chain from the feed bracket.

Tool feed is independent of the high-speed indexing movement and is controlled by trip pins carried in Tee slots in the face of the worm wheel that can be adjusted to suit the length of the cut. The pins engage a pawl on the trip lever shifting the clutch from high to low or vice versa.

"Cataract" Milling Machine



Hardinge "Cataract" Miller

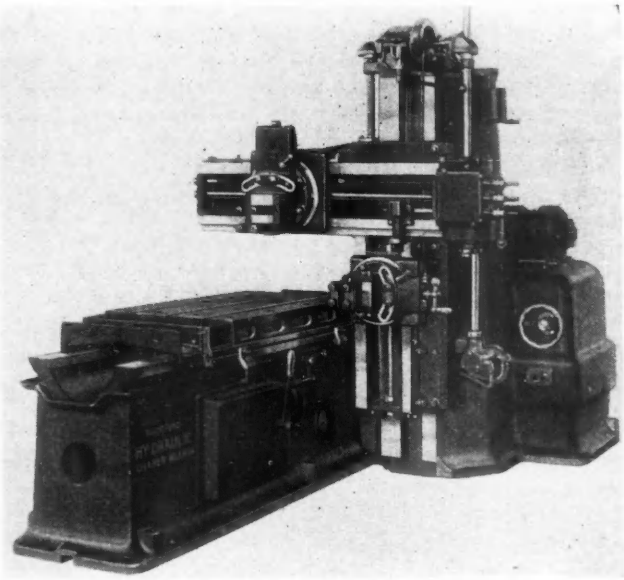
THE No. 5 "Cataract" Universal Bench Milling Machine is a new product just placed on the market by Hardinge Brothers, Inc., Chicago, Ill. The working range is 12 in. longitudinally, 6$\frac{1}{2}$ in. transversely, 6$\frac{1}{2}$ in. vertically. All movements are controlled by adjustable dials graduated in thousandths of an inch.

Hy-Draulic Shaper-Planer

THE Rockford Hy-Draulic shaper-planer was shown by the Rockford Machine Tool Co., Rockford, Ill.

A feature of this machine is the fact that both table and feeds are operated by hydraulic power. An Oilgear pump operates an hydraulic cylinder which is mounted in the bed close up under the table. The piston of this cylinder is directly connected to the table and exerts a maximum pull of 10,800 lb., giving ample smooth-flowing power for heavy duty, high production. Any desired cutting speed up to 75 ft. a minute is available. Table reversals are smooth and shockless. Ratio of cutting speed to return is one to three.

Hydraulic power for the feeds is provided by a separate pump. There are 20 horizontal feeds ranging



Rockford Hy-Draulic Shaper-Planer

from .010 in. to .200 in. and an equal number of vertical feeds ranging from .004 in. to .080 in. Feed takes place after the table returns and before the cut starts.

A small electric motor at the top of the column supplies power for raising and lowering the counterbalanced rail and for rapid-traversing the rail-head in either direction. Interlocking mechanisms, automatic trips and shear pins protect the machine against damage.

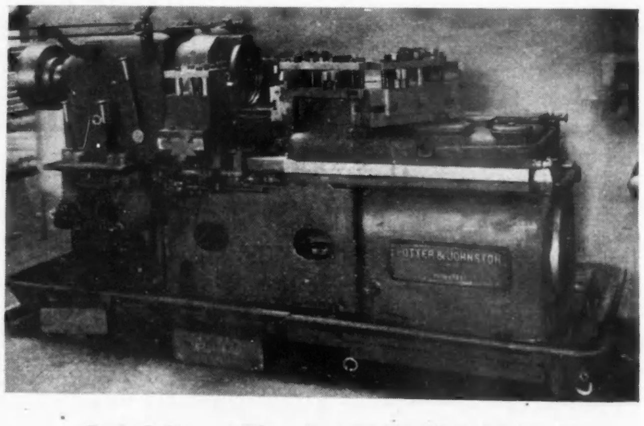
Another pump forces filtered oil to the ways—about the only bearings on the whole machine which require this type of lubrication because of the hydraulic drives. Controls are centralized and conveniently located.

Floor space required for the standard machine is 58$\frac{5}{8}$ in. x 119 in.

P & J Automatic Platen Turret

THE platen turret is a new feature made available on the 5-D Power-Flex Automatic built by the Potter & Johnston Machine Co., Pawtucket, R. I.

This machine is the standard 5-D Power-Flex with the addition of the new platen turret. The platen turret adapts this automatic to work which requires quick changes and short runs. Another feature is that the turret is designed for simple tooling, such as forged tools and boring bars commonly used on hand-operated machines. Ample power and rigidity of

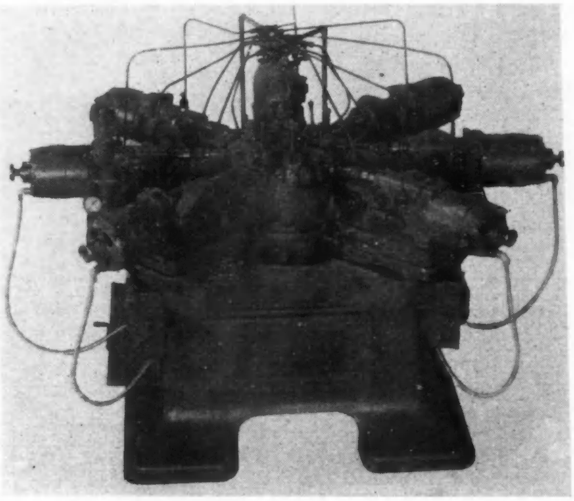


P & J Power-Flex Automatic Platen Turret

mounting are provided for the use of cemented tungsten carbide tools.

Drilling and Tapping Machine

AN automatic dial feed drilling machine is featured by the Kingsbury Machine Tool Corporation, Keene, N. H. This machine consists of a standard

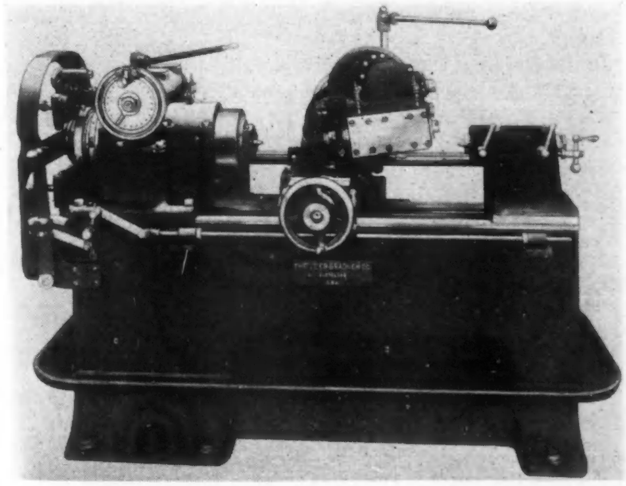


Kingsbury Dial Feed Driller

base and central fixture with provision for mounting individually driven drilling heads on the base. These heads can be mounted in any position, vertically, horizontally, or inclined, and thus are adaptable to a variety of special operations which become high cycle production jobs.

Heavy-Duty Thread Miller

THE heavy-duty thread miller is a new addition to the line of the Lees-Bradner Company, Cleveland. The rated capacity of this machine is 2½ in. circular pitch in steel. Eighteen cutter speeds are available through the two-speed reduction to the heavy spindle in the cutter head and an extra interchangeable lighter spindle can be supplied, providing two more reductions with 18 additional cutter speeds —a total of four reductions and 36 cutter speeds with two spindles.



Lees-Bradner Thread Miller

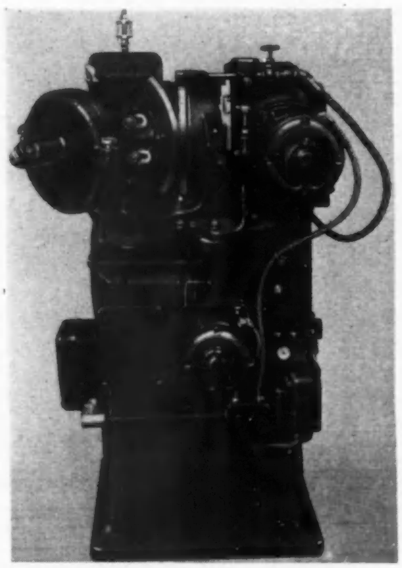
Cutter spindles are hardened, ground and lapped, steel to steel, and careful provision is made for accurate and quick interchangeability of the complete units. The two speeds in the cutter head are readily available through a handy shift lever over the head.

The reduction gears in the head are heavy steel forgings, all mounted in ball bearings, and arranged for take up. The micrometer cross slide is gibbed to square ways on the saddle. The head swivels through 180 deg. by means of a worm and wheel actuated with a crank. The lead screw is completely covered over its entire length and double nuts under the saddle provide for take up and the elimination of backlash. The cutter drive, off the main shaft, has a reversing mechanism for the quick changing of cutter rotation direction. The standard work spindle has 2¾-in. capacity and at a nominal additional charge this can be increased to 6 in. through the spindle. Steel ways on the bed and cross slide can be added at an additional charge.

Bevel Gear Generator

A NEW straight bevel gear generator was shown by the Gleason Works, Rochester, N. Y. Straight bevel gears up to 4½ in. pitch diameter, 2¼ in. cone distance and 10 D. P. can be cut on this new machine. It is designed for either large or small production, and will both rough and finish in either one or two operations, depending upon the pitch and quality of work desired.

The generating principle by which gears are finished on this machine is the same as used in previous Gleason straight bevel gear generators. The tooth shape is developed by rolling the teeth between the reciprocating tools which represent adjacent sides of a tooth in an imaginary crown gear.



Gleason Bevel Gear Generator

One of the marked improvements of this machine is the quick throwout mechanism which enables the operator, by a single throw of a lever, to move the tool head into or away from cutting position. The work segments are adjustable so that each segment can cover a range in pitch angles from about 1 deg. on small pinion segment to 7 deg. on the largest gear segments. Thirty-two segments cover the entire range of the machine.

A circulating oil system built into the tool head furnishes a constant supply of clean oil to the tool drive and to the arms and slides, while another circulating oil system built into the feed bracket circulates oil to all points of the feed mechanism.

Feeds and speeds are regulated through easily accessible change gears. Feeds are available from 1½ to 30 seconds per tooth and tool stroke speeds range from 200 to 800 per minute. This machine is furnished with built-in motor drive only. A ½ hp. motor drives

the tools and a $\frac{1}{4}$ hp. motor drives the rest of the machine. Required floor space is 27 in. x 31 in.

Racine Hydraulic Power Saw

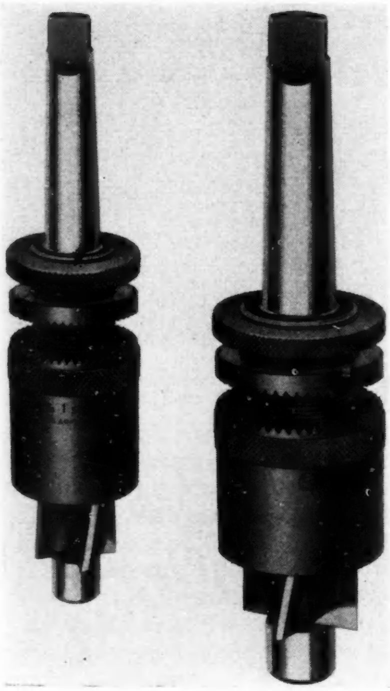
A NEW hydraulic power saw is offered by the Racine Tool & Machine Co., Racine, Wis. The feature of this machine is the Racine Oilmotor which supplies power to the saw and also reciprocates the saw frame. Among the advantages claimed for a hydraulic saw is that of constant, controlled rate of speed which is maintained throughout the stroke. A wide range of cutting speeds and adjustable stroke are other features of hydraulic control.

This machine is said to embody some novel features of design. One of these is the guiding of the saw frame and its alignment by means of heavy gibs and wide bearing surfaces. Provision is made for using special high-speed blades of resharpenable type, with widely spaced teeth. These blades are essential for heavy production work. Standard blades may also be used.

Quick-Adjustable Holders

TWO new types of quick-adjustable holders are announced by the Eclipse Counterbore Co., Detroit. The Stop-Collar Holder is recommended for use when counterboring, spotfacing, countersinking or core drilling to a specified depth. The stopping of the collar against the work or the fixture bushing regulates the depth of cut. Instant adjustment by hand is made available. To make the adjustment, the upper lock nut is backed off and the serrated drive washer is lifted. Then the stop collar is turned to the desired position, the drive washer is lowered and again locked in place.

The Quick-Adjustable-Length Holder is another type of holder which is available in an improved form. This is particularly adapted to multiple spindle spotfacing, counterboring, countersinking or core drilling to specified depth, or with cutters of varying lengths. Fine screw thread adjustment with a sliding locking collar makes this an ideal adjustable length holder for high production operations. Adjustment either up or down is accomplished by lifting the locking collar by hand and revolving the holder on its shank until the proper length is obtained, then lowering the locking collar into the driving position. This holder is made in two types, one with square driving lugs for driving right or left hand, the other with a ratchet drive to permit of finer adjustment.

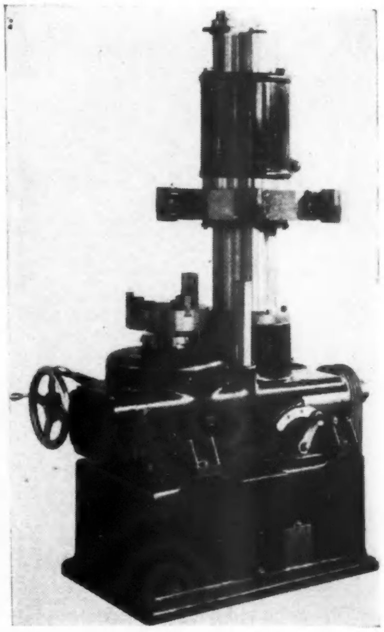


Eclipse Adjustable Holders

Vertical Chucking Machine

A NEW turret type vertical chucking machine has been developed by The Columbia Machine Tool Co., Hamilton, Ohio. The hexagon turret is cam-operated and indexes automatically. It is positioned rigidly by the massive vertical key shown at the left on the column. A horizontal hand feed slide is also provided and can be tooled for operations in the side of the work.

This machine is designed to permit the use of the new alloy cutting tools. For this purpose, it is capable of high speeds, and all parts are of large proportions to provide rigidity. An example of this feature is noted in the turret column which is 10 in. in diameter. Effective swing at the chuck is $16\frac{1}{2}$ in.



Columbia Vertical Chucker

Optical Aids

THE Bausch & Lomb Optical Co., Rochester, N. Y., announces a line of optical instruments designed as aids to precision in the machine shop and tool room.

Piston Machining Practice

(Continued from page 529)

3. Rough drill and ream pin hole on two-spindle Avey, two pistons at a time, locating from open end.
4. Machine four slots through lowest land on Chrysler special machine with shaper action slotting tools, four heads and automatic vertical feed. Locating is from pin hole.
5. Saw horizontal slots in lower ring groove on Burke bench mill, locating from pin hole.
6. Finish face and chamfer open end on W. & S. turret lathe, locating with pin plug in pot chuck.
7. Finish turn OD, one and three lands, finish groove and chamfer top and bottom between centers on LeBlond Multicut.
8. Cut oil ring groove in pin hole on Avey single-spindle drill press with differential feed spindle for feeding out cutting tool in pilot shank.
9. Finish turn two and four lands (tungtite rings) and cam turn the skirt OD on a Chard or Sundstrand lathe between centers.
10. Grind OD between centers on Landis grinder.
11. Wash.
12. Semi-finish and finish ream pin hole on speed lathe with piloted cutters.
13. Drill expansion slot relief hole on L. & G. bench drill press.
14. Drill oil holes in two operations on L. & G. bench drill presses.
15. Burnish wristpin hole on P. & W. lathe.
16. Finish face head and burr piston on Cincinnati lathe.
17. Saw expansion slot on Whitney hand mill, locating from pin hole.
18. Burr skirt end, wash and inspect.

Tool Standards and Construction Discussed at *S. A. E. Forum*

Special-purpose production machines built from regular parts readily are converted to suit altered requirements, J. B. Armitage tells Congress at Cleveland.

THE fourth session of the Second Machine Tool Congress, held in Cleveland last week under the auspices of the Production Committee of the Society of Automotive Engineers, was an open forum, with A. K. Brumbaugh presiding. The following interrelated topics were dealt with:

1. Application of Standard Machine Tools to Automobile Manufacture.
2. Results in Production Due to New Features of Machine Tool Construction.

J. B. Armitage, of the Kearney & Trecker Corp., read an interesting paper dealing with the possibilities of building up special-purpose production machines from standard parts. He pointed out that certain standard machines may be readily converted to suit special requirements by means of interchangeable driving heads, spindle heads, tables and beds. A particularly important angle that he brought out was that a built-up machine of this nature could be salvaged almost entirely when a change in car design occurs, and could be adapted to a new design by a rearrangement of units coupled with the addition of new ones if necessary. The talk was supplemented by lantern slides showing combinations and rearrangement of standard units to form various special-purpose production layouts.

A. K. Brumbaugh, of the White Motor Co., who presided at the Production Forum of the S.A.E. in Cleveland last week

A letter received from one of the large truck manufacturers voiced the opinion that the automotive manufacturer wants standard machine tools. This manufacturer sees the tendency toward automatic machines wherever possible. He also insists upon new machines with present-day improvements such as automatic lubrication, anti-friction bearings and rapid-traverse mechanisms.

D. Ayr voiced the idea of several others when he stressed the desirability of developing means for separating chips and turnings from the work. He also asked for suggestions leading to the removal of burrs from finished work.

E. P. Blanchard of the Bullard Co. interjected another thought about standard tools when he said that the automotive industry really needs universal machines of the productive type with adaptability to related kinds of work. He touched on some of the new improvements, such as motor drives, lubrication, hydraulic mechanisms and anti-friction bearings. A warning note was sounded when Mr. Blanchard suggested that the present trend in bearing mounting may lead to difficulty because of higher speeds and the demand of new cutting alloys.

Several other speakers commented upon the growing use of hydraulic mechanisms for indexing, feed and other control functions. They were in agreement that hydraulic mechanisms tended toward simplified control and greater flexibility of operation.

Mr. Keith told of instances where the hydraulic mechanism had failed to function satisfactorily. Several speakers agreed with him that changes in viscosity of the liquid after it heated up affected the speed of the feed mechanism. In some cases a difference of 25 per cent has been noted. Nevertheless, Mr. Keith felt that the hydraulic mechanism is a valuable tool for control arrangements and certain grinder applications.

D. M. Millholland, in speaking of special machines, said, that basically, a special machine is a standard machine with certain standard units mounted in various groupings about a standard base. An important point that he developed was that the special machine is intended for a long season run on certain parts or series of parts and that it pays for itself in the speed, reliability and economy with which it turns out the work.

He drew attention to the fact that there is a limit to the number of operations that might be performed in one setting. One practical limitation lies in the amount of work involved in adjusting or resetting tools after breakage or to compensate for wear.

E. F. DuBrul, general manager of the National Machine Tool Builders' Association, suggested a number of improvements, one of which was that study be made of handling work automatically in loading and unloading. Then he touched again on the matter of separating chips and burrs from work. One practical suggestion he made was that the machine designer should work in the plant of the user, study his problems and difficulties there, and then find the right solution.

Machine Tool Construction Reflects of Cemented *Tungsten Carbide*

Possibilities of the high-speed cutting alloy revolutionizing the tool industry within the next three years are indicated by Dr. Zay Jeffries before A. S. M. E.

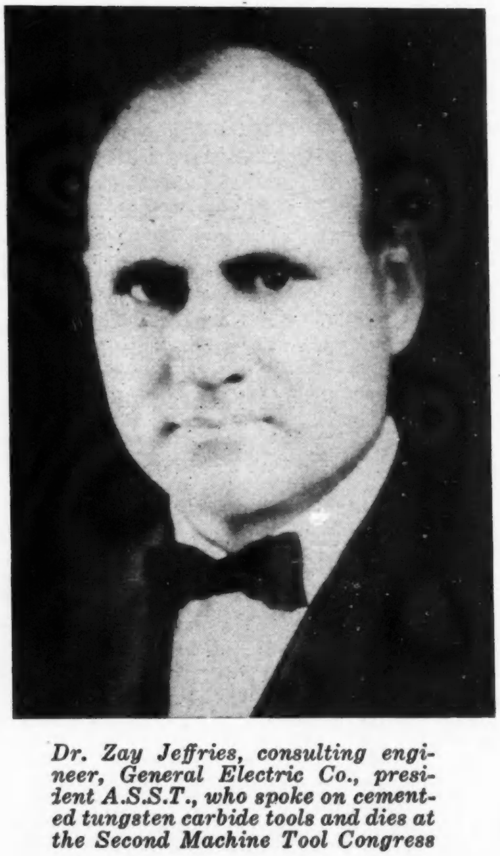
TRIBUTE to machine tool builders for the rapidity with which they have adapted their machines to requirements for employing cemented tungsten carbide was paid by Dr. Zay Jeffries, consulting engineer of the General Electric Co., of Cleveland, and president of the American Society for Steel Treating, last week at the second session of the Second Machine Tool Congress held in the Hotel Cleveland, Cleveland.

Dr. Jeffries expressed the compliment in discussing "The Present Status of Cemented Tungsten Carbide Tools and Dies" at the second of two sessions of the Congress held under the auspices of the Machine Shop Practice Division of the American Society of Mechanical Engineers. Even standing room was taken at the meeting at which the chairman was Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt.

His commendation was evoked, Dr. Jeffries said, by evidences of advancement in providing for the use of cemented tungsten carbide seen at the Second National Machine Tool Show held in the Cleveland Public Auditorium and Annex simultaneously with the Congress. He reminded his audience that developments in this connection seen at the show had been realized within the period of only slightly more than a year since the new high-speed cutting alloy had become generally and popularly known. In reviewing briefly the history of the alloy, however, Dr. Jeffries revealed that a relative of the present product had been known as far back at least as the middle or last third of the last century.

Demand for tools utilizing the cemented tungsten carbide within the last few weeks had brought pressure to bear upon the producing organizations, he said, although for the preceding three months the output had been greater than was required. He predicted that it would be possible to turn out the tools at an ever-increasing rate, which he foresaw as a necessity if the demand is to be met. Dr. Jeffries also forecast that if another machine tool exposition is not held until the end of three years, that exhibits then displayed will reveal that there has been a revolutionary change in machine tools as a result of the development of cemented tungsten carbide.

The present price of the alloy, which is around $450 a pound, will be reduced in the future, Dr. Jeffries assured his hearers, saying that it would be brought into a range commensurate with the cost of exploitation. The alloy is destined, he said, not only to have a place in the future of industry, but a most important place, emphasizing that there can be no doubt that cemented tungsten carbide or its approximate equivalent will be used in large quantities and for a great variety of purposes in the future. Dr. Jeffries cautioned his audience, however, not to consider the material as a cure-all in the tool industry, although he voiced a conviction that a number of grades of the alloy with a considerable range of properties will be available in the future.



Dr. Zay Jeffries, consulting engineer, General Electric Co., president A.S.S.T., who spoke on cemented tungsten carbide tools and dies at the Second Machine Tool Congress

The high cost of the material which has prevented its more extensive use to a certain extent has been lowered somewhat by the tipping process, Dr. Jeffries explained. It has been found possible, he said, to put the cemented tungsten carbide tips on steel shanks by copper brazing in an atmosphere of hydrogen with 100 per cent satisfaction in most cases. There seems to be a preference for the welded tips for larger tools, he said, adding that knowledge of the art of tipping is not widespread enough to permit its general practice successfully at present. Dr. Jeffries explained, however, that where the tipping process has not been mastered, tools desired may be designed and ordered complete and then received in the finished state.

The problem of grinding the tools has been solved by certain firms in the United States, Dr. Jeffries said, that now sell grinding wheels suitable for the grinding of cemented tungsten carbide. The base material for most, if not all, of these grind-

Rapid *Development* in Employment

ing wheels, he said, is silicon carbide carborundum, or crystallon.

Dr. Jeffries recited a number of interesting uses for cemented tungsten carbide.

"There seems to be a tremendous field for wire-drawing dies, or in general drawing dies," he said. "I will give you two examples, one drawing screen wire of .0108 in. in diameter, the other drawing larger wire, a little over 1/10 of an inch in diameter. The reason I give the two cases is that in one field what might be called the competing material is the diamond die and in the other the competing material is the chilled iron die. In the first case, the cemented tungsten carbide die drew 57,800,000 ft. of wire, .0108 in. in diameter, with a wear of 7/10,000 of an inch in diameter. At this size the performance was approximately equivalent to that of a diamond die, but with more cuts possible in the cemented tungsten carbide. The overall improvement in cost on a performance basis over diamond was 6 to 1. The second example is the drawing of steel wire, .105 in. in diameter. Over a 12-day period there were 264 chilled iron dies used in this line. Over the same period one cemented tungsten carbide die performed without going off size. We had, therefore, one cemented tungsten carbide die taking the place of 264 chilled iron dies. On a basis of die cost alone, the cemented tungsten carbide was cheaper than the chilled iron by a ratio of 36.6 to 18. In addition to that 20 per cent more wire was produced during the period on the one cemented tungsten carbide die than was produced on the 264 chilled iron dies. Also the cemented tungsten carbide dies are being used for hot drawing of tungsten and molybdenum, and we perhaps will hear more in the future about the use of this material in hot drawing of other materials.

"The material is also usable as a blanking die and in particular in the General Electric Co. in punching out transformer disks. It is found that the cemented tungsten carbide blanking die produces a material free from burrs. In a test of 200,000 parts the first one and the last one appeared to be just alike. This material is used for cutting materials which no other metallic material has been able to cut.

New Fields Opened

"In that sense, cemented tungsten carbide is opening up a new field for machining. Machining is only one method of shaping articles. Machining has been used to a much greater extent in shaping metals than it has for everything else combined. Cemented tungsten carbide can machine glass, it can machine porcelain, it can machine compounds used in electrical industry such as micalens, it can machine ivory and things of that sort. It machines various non-metallic materials known as the fibrous materials which are abrasive, those containing mixtures of asbestos and other materials used in brake linings, for example, and the machine materials, molded products of the bakelite type. In some instances it replaces the diamond in those operations, but in other instances it makes possible the machining of parts which heretofore could not be shaped economically by machines with any known tool.

"The material is also used for cutting rock. It can be used to saw rock, replacing the old-time saw teeth of other materials with cemented tungsten carbide so that outside of the machining industry itself you can see that cemented tungsten carbide has a potentially wide application.

Examples of Replacement

"Now in the machining industry I am going to take a few examples of mere tool replacement. It should be obvious that when a new tool material with the capabilities of cemented tungsten carbide is brought on the market, machines designed to use tools with different physical properties might not be able to take full advantage of this new material; nevertheless the machines which have been made during the past 5, 10 or even 15 years have been adapted in a way to use this material, and whereas one would not expect a maximum performance from these machines, it is interesting to see what performance one gets.

"For example, here is a case aluminated armature, and by the old tooling methods and tools the performance was one armature per grind of the two. With cemented tungsten carbide the rate is 40 armatures per grind, the speed is 700 ft. per minute, hand feed, and 1/64 in. cut.

"Here is a commutator, rough and finished turning. The old record with the existing tools was 150 commutators per grind; with cemented tungsten carbide, 30,000 per grind.

"Another example is a cut-off tool: the old performance, 100 cuts per grind; with cemented tungsten carbide, 15,000 cuts per grind.

"Here is an example of profiling of ten-twenty (1020) S.A.E. steel at very high speed: with the old practice, 60 pieces between grinds, and with cemented tungsten carbide, 25,000 pieces.

"Ivory is turned at 6000 ft. per minute, hand feed, with only a skin cut, but the result is about the same as that obtained with the diamond tool.

"Here is an interesting thing in connection with a finished boring of a bronze bushing. The size limit, tolerance limit, 5/10,000 of an inch. The old record with existing tools was 150 pieces per grind, and with cemented tungsten carbide, 7000.

"There was, with the cemented tungsten carbide only 5 per cent of the machine scrapped that was obtained with the other tools. That is a very significant point I think, namely, that in machining to close tolerances the longer the life of the tool the less the machine scrap, because the more nearly the piece will be machined to a point within the tolerances.

"Here is a reaming operation, malleable iron differential carrier with 3¾-in. diameter hole, it is cut at 70 ft. per minute with a 1/64 in. cut and hand fed. There were with the old tools one to two adjustments per day, and with cemented tungsten carbide one tool had been running for 11 weeks without changing.

In almost every plant where cemented tungsten carbide tools have been introduced, the production has been increased, Dr. Jeffries said, the range being from around 15 per cent to even over 100 per cent.

Line Drawings Help Tool Salesmen, Say Many at *A. S. M. E. Session*

Detailed information and not generalities is sought by prospective purchasers, declare men discussing paper by G. T. Trundle, Jr.

George T. Trundle, Jr., whose paper on sales information for the machine tool buyer was the principal topic at the opening session of the Machine Tool Congress last week

LINE drawings, longitudinal sections and cross sections and not photographs compose the sign language of machine tool users, it was the consensus of many of those who discussed the paper entitled "What Information Does the Machine Tool Buyer Need From the Machine Tool Salesman?" which was presented at the opening session of the Second Machine Tool Congress held in Cleveland last week. The meeting was under the auspices of the Machine Shop Practice Division of the American Society of Mechanical Engineers.

Detailed information, in other words, and not generalities, is sought by prospective purchasers in considering such equipment, it was emphasized, regardless of whether the units are handled through salesmen representing the manufacturer or salesmen associated with an agent who deals in a complete line of machine tools together with a variety of labor-saving devices. The discussion was conducted with Philip E. Bliss, president of the Warner & Swasey Co., Cleveland, presiding.

"Personally, if I were buying for a manufacturing plant I would prefer dealing through a good reliable agent," it was stated by the author of the paper, George T. Trundle, Jr., president of the Trundle Engineering Co., of Cleveland. His paper was read by C. O. Malpas, vice-president of the Trundle Engineering Co., because Mr. Trundle was unable to be present.

The buyer of machine tools should know "Who, what, when, where and why," about every installation he purchases, in the opinion of Mr. Trundle. He should know:

"Who made it? Is he reliable? Is he experienced? Will he be in business if the article needs repair or replacement?

"What will the article do for you? Will it improve your appearance? Will it save you time, money, effort? Will it make you more comfortable, more happy?

"When was it made, designed, packed? Is it fresh? Is it the newest model or latest development?

"Where can you buy it? Does your own store carry it? If not, can you place dependence on the store that does?

"Why should you buy it in preference to some similar product? Is it superior in design, materials, workmanship? Will it fit your needs more closely?"

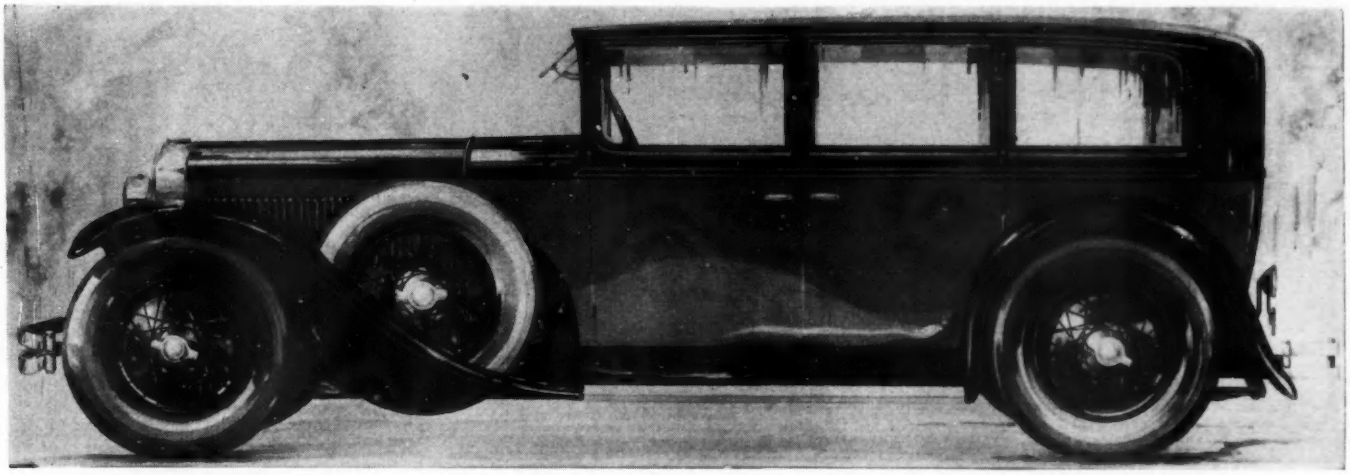
Turning to the topic of the length of time that should be allowed for a machine tool to earn its cost, Mr. Trundle declared that:

"The buyer who has as a fixed policy, and lives up to it, that he will never buy a piece of equipment unless it pays for itself in one year or less, is losing money and is headed straight for bankruptcy."

"When I hear the statement from some man that I know to be at the head of a given organization," he continued, "I immediately call on Dun's for a financial report on that company. If the report reveals that the company's profits are decreasing, I consider the man was telling the truth. If the report reveals their profits are increasing, I know he is not telling the truth. I want to make the statement that not more than 10 per cent of the machine tools sold pay for themselves in less time than two years."

Speaking of depreciation, Mr. Trundle said that one of the things the buyer wants from the machine tool salesman, but does not know it, is a continuous sermon on the subject of using his reserve for depreciation to keep the plant equipped with modern machine tools at all times.

"In ending," said Mr. Trundle, "I want to say that the machine tool manufacturers who are preaching modern equipment to their prospective customers must install some of this more modern equipment and modern methods in their own plants and not operate on the theory that the reasons their costs are high is because labor is not efficient, for labor is just as efficient as management plans for it. It is just as efficient as what the tools management gives it to work with."



The Lancia V-eight Dilambda, exhibited at the Paris Automobile Show this week

Increase in Eight-Cylinder Models Is Feature of Paris Show

Five European companies have begun the production of that type of engine since the last exposition at French capital. One twelve-cylinder automobile is exhibited.

By W. F. BRADLEY
Special Cable to Automotive Industries

THE passenger car and accessory section of the twenty-third annual Paris Automobile Show opened Oct. 3 in the Grand Palais with a record number of more than 1200 exhibitors occupying 240,000 sq. ft. of floor space, and having exhibits valued at $4,000,000. Of the car manufacturers exhibiting, 58 are French; 31, American; 9, German; 7, Italian; 6, English; 3, Belgian; 1, Austrian, and 1, Czechoslovakian. American firms generally have poor positions, while several European concerns not yet in production have central booths. President Doumergue of the French Republic visited the show Oct. 4. The exhibition will close Oct. 13.

A still further increase in the number of eight-cylinder models is a feature of the show, the total number of such models exhibited being 26, of which the following five are new since last year: Talbot, Bugatti, Delage, Minerva (sleeve valve) and Lancia (narrow V). Fiat announced an eight-cylinder model, but the car was not at the show on the opening day. Two of the eights built by small French firms have Lycoming engines. The biggest eight has a piston displacement of 434 cu. in.; the smallest, 122 cu. in.

With one exception, all eights have overhead valve engines. The more expensive models have aluminum cylinders with liners, but the general tendency is away from the use of aluminum. Nitralloy steel is being used for liners on the Hispano and the Talbot. The latter also has duraluminum rods which bear directly on the Nitralloy shaft without babbitt lining. The only 12-cylinder model at the show is a sleeve-valve Voisin of 235 cu. in. piston displacement.

The tendency is toward four-speed transmissions with silent thirds. Several of these transmissions are imported in whole or in part from America. Makers using silent thirds are Mathis, Panhard, Talbot and Delage.

Citroen changes include the use of a hand brake on the transmission in both the four and six-cylinder models; a 90 amp.-hr. battery, a 56-in. tank for the six-cylinder model, Silentbloc bushings for the springs and strengthened frame members.

Peugeot has produced a new cheap car with a four-cylinder 60 cu. in. engine developing 24 hp. It has a wheelbase of 100 in. and sells at $800. The four-passenger sedan of this line is the cheapest four-passenger car at the show.

The Cord front-drive is attracting a lot of attention, the only European front-drives at the show being the Tracta and the Brasier, both of which have very small production. However, half a dozen makers are known to be experimenting with front-drives. The Duesenberg, which is being exhibited for the first time, appears to have a good reception.

Fabric bodies have practically disappeared. Even Weymann is building the metal type of sections which are united flexibly. Hibbard & Darrin are displaying an all-metal body consisting of a duraluminum, aluminum and alpax frame with sheet aluminum paneling.

Buying was reported calm on the first two days. The atmosphere of the show revealed a marked nervousness regarding the so-called American menace, French newspapers pointing out that American banks are securing financial control of the leading French firms and dictating their policy.

First with the News

AUTOMOTIVE INDUSTRIES

News of the Industry

Reliable, Accurate

PAGE 556 VOLUME 61 *Philadelphia, Saturday, October 12, 1929* NUMBER 15

Logical Recession Shows in Production Schedules

PHILADELPHIA, Oct. 12—Having exceeded the total production of 1928 in the first 9 months of this year, the automobile industry has entered the fourth quarter with operating schedules showing a logical recession. Whether curtailment this month will bring the total October output to a figure below that of October last year, when factories of the United States and Canada turned out 415,820 cars and trucks, is problematical in the face of the situation in September of this year when, for the first time in the year, production fell below that for the corresponding month last year.

The total output for the industry for last month was estimated at 417,035 vehicles—as announced in *Automotive Industries* last week. There are indications that this month's output may show a slight decline from that of September, but such signs are too early to permit an accurate prediction.

Adding the estimated September production to the Department of Commerce's figures for the first 8 months of this year gives a total of 4,860,035 vehicles for the first 9 months of 1929. This compares with production in the corresponding period last year of 3,672,871, a difference of 1,187,614. It exceeds the total of 1928 production of 4,601,141 by 259,344.

Despite this startling accomplishment, which only the most optimistic followers of automobile production trends dared to predict at the start of the year, new car stocks have shown a downward trend in the past few months. Stocks of used cars, however, have displayed an upward tendency, a condition natural to the accompaniment of the unprecedented greater-selling season of the year. It is largely toward the reduction of stocks of this latter class of merchandise that the dealers in many parts of the country will continue to direct their efforts in the next several weeks. Sales of new cars are reported to be continuing favorably and in keeping with the normal seasonal trend.

The prediction made several weeks ago in *Automotive Industries* that production in the first ten months of this year would reach 5,000,000 vehicles now appears assured. As it requires an output of only 139,515 vehicles during the current month to put this on record, the predicted figure will be reached early in the month.

Robert W. Woodruff

new president of the White Motor Co., continuing as president of the Coca-Cola Co., Atlanta, and so occupying an almost unique position as active head of two companies in unrelated lines

Overland Declares Dividend

TOLEDO, OHIO, Oct. 8—At a meeting of the directors of the Willys-Overland Co., today, a quarterly dividend of 30 cents on the common stock was declared payable on Nov. 1 to holders of record Oct. 18, which will mean distribution of approximately $900,000 to shareholders. Quarterly dividend of $1.75 on preferred, payable on Jan. 2 to holders of record Dec. 16, was also declared. A report of sales betterment was made at the meeting.

Woodruff Outlines White Co. Policy

New President Expects to Intensify Sales Effort

ATLANTA, Oct. 9—Returning here after the announcement of his election as president of the White Motor Co., Cleveland, on Oct. 2, Robert W. Woodruff, president of the Coca-Cola Co., made the following statement to *Automotive Industries* concerning his plans for the future of the White Motor Co.

"I had been associated with the late Walter C. White in different capacities in the White organization for the past seventeen years. No two men have more thoroughly enjoyed each other's confidence or have worked in closer harmony and accord in fixing the policies of the White Motor Co. When I became president of the Coca-Cola Co., Mr. White came with it as a director, which gave that company the benefit of his wide experience, and at the same time I remained a director of the White Motor Co., and made such contributions as I could toward the success of that company.

"I feel that the policies already in force should be continued with an intensification of the sales effort. That the policies thus established have been successful would seem to me to be evidenced by our production and sales for the first nine months of the year; by our ratio of current assets to current liabilities of more than eight to one; by our new and used car inventories—which are the lowest in our history; by the volume of orders now on hand—which exceed that total on hand a year ago; and by the confidence which those policies have earned in the minds of the company's more than eighty thousand customers.

"Mr. White leaves the White Motor Co. in the best condition, from every standpoint, that it has been in many years. During his life, I liked to feel that I was in some sense a partner of his in his accomplishment, and now that the responsibility has devolved on me, I feel complete confidence in the future as we carry on the policies which he instituted."

At the same meeting at which Mr. Woodruff was elected president, the

(Continued on next page)

Overland Adopts Flexible Schedule

President Miller Says Demand Fluctuations Must be Met

TOLEDO, Oct. 9—That annual boosting of production by motor car manufacturers is causing a serious problem in distribution of automobiles affecting employment, sales and almost every factor in the industry and should be stopped, was the central theme of a statement issued by L. A. Miller, president of the Willys-Overland Co., on Wednesday. Mr. Miller said in part:

"The ability of the public to absorb an indefinitely increasing number of cars is constantly over-estimated. As a result, from the first month of this year we have seen automobile plants running at record production. Dealers have had cars shipped to them in excess of the purchasing power of their communities, creating a problem of meeting loans from banks and finance companies.

"Long trades with the selling of cars at net loss to the dealer is the result. And dealers find that although they have done an increased volume of business their profits have dwindled or losses have been sustained. The used car problem of today is the direct result of this policy of overbuilding on the part of the manufacturers.

"This year we will produce in the neighborhood of 300,000 cars. We do not plan to increase this total next year. We believe it is the conservative number of cars dealers can move without the need of forced selling, unprofitable trades, excessive used car stocks, and with turnover in their capital to assure a sound return on their investment at the end of the year. We will keep our productive capacity absolutely flexible so that as dealer outlets increase and resulting increased retail demand warrant expanding our output we can do it promptly and efficiently."

A.S.M.E. to Celebrate Fiftieth Anniversary

NEW YORK, Oct. 7—The fiftieth anniversary of the founding of the American Society of Mechanical Engineers will be celebrated April 5, 7, 8 and 9, according to plans announced here by the society. The exercises in celebration will be non-technical in nature and will stress the humanistic side of engineering accomplishment. They will include the presentation of 16 papers by a prominent engineer from each of 16 geographical divisions of the world.

The program will be conducted in three parts. On April 5, the delegates will be entertained by the *American Machinist* in New York. The second portions of the program will be held at Stevens Institute, Hoboken, April 7.

Federal Aid Built Mileage Announced

WASHINGTON, Oct. 8—A total of 78,797 miles of Federal aid highways had been completed Aug. 31, according to figures compiled by the Bureau of Public Roads, and recently made public. The three states having the greatest number of miles of such highways on that date, according to the bureau, were: Texas, 6141; Minnesota, 3854, and Nebraska, 3559 miles. The lowest number of miles completed was in Rhode Island and Hawaii, where 172.1 miles were completed in the state and territory respectively.

Woodruff Outlines Policy

(Continued from page 556)

directors of the White Motor Co. elected four vice-presidents. Saunders Jones was elected vice-president and assistant to the president. George H. Kelly was elected vice-president and treasurer. H. D. Church, vice-president in charge of engineering, and George W. Smith, Jr., vice-president in charge of production.

Nash Profits Drop for Third Quarter

Suspended Operations Preceding New Models, Assigned as Cause

NEW YORK, Oct. 9—Nash Motors Co. reports for the quarter ended Aug. 31, 1929, a consolidated net income of $3,068,658 after depreciation, Federal taxes, etc. This is equal to $1.12 a share on 2,730,000 of no-par stock, and compares with $6,623,329, or $2.42 a share in the preceding quarter and $6,666,853, or $2.42 a share, in the August quarter of 1928.

The consolidated net income for the nine months ended Aug. 31 totaled $13,810,857 after charges noted above, equal to $5.05 a share, against $12,039,-704, or $4.41 a share, in the corresponding period of the previous year.

The regular quarterly dividend of $1.50 a share of the common stock was declared payable Nov. 1 to stockholders of record Oct. 19. In commenting on the above report, C. W. Nash, president, pointed out that plant operation had been suspended for six weeks in preparation for the announcement of new models and that expenses incurred in the same cause had been unusually heavy.

Bright Bodies Shown at Paris Salon; Fabric Types on Very Few Models

PARIS, Oct. 5 *(By cable to Duco Information Service)*—The use of bright colors in the decoration of motor cars is an outstanding characteristic of the 1929 Automobile Salon, now open here. Although there is a wide range of shades shown, green seems to predominate. This color is not only used as a finish for the body but is also revealed in striping and trimming. It appears in all hues from very light to dark.

Beiges and greys are also represented in a substantial number of cars, although in most cases, they are mixed with other colors. Dark reds, tending toward maroon, have also made progress but are not represented so importantly as the brighter colors.

Orange and maroon as finishes are scarcely seen at all, but quite a few yellow cars are on view. Purple as a finish is shown on about six cars. Half of this number are exhibited by American manufacturers and the others by small French concerns. A substantial number of cars are on view in this show, as in others, finished in black and dark blue, these being standard shades for town cars.

The Weymann fabric body, which was such a distinguishing feature of shows during previous years, has practically disappeared, not more than a dozen cars in the whole Salon showing that style of finish, and these being on display chiefly by British concerns. Lacquers, developed in America, are used on practically all cars at the salon.

Disk wheels are in evidence on from 80 to 90 per cent of the cars. These are plain metal in some cases, and in others finished with the color of the car. Sometimes they follow the shade of the striping. Wooden wheels are also shown.

There are also a few wire wheels finished mostly in black or with a white metal appearance. A few are finished in the color of the car or of the striping, the color of the wheels being always lighter than the color of the car. Colored fenders are everywhere in evidence. They are sometimes finished in a companion color to that of the car. Sometimes they match the striping or belt.

In some cases efforts have been made to change the appearance of the louvers. Some are horizontal, others in two rows, still others are concave. Some are planned to produce a spiral or staircase effect. One car had two large, open, oblique louvers on each side with a white metal outline. Chromium nickel is widely used.

Men of the Industry and What They Are Doing

Nagelvoort Resigns; Widman Goes to Europe

Bernard Nagelvoort has resigned as plant manager of the Murray Corp. of America, a position he has held for the past two years. Mr. Nagelvoort figured largely in the recent plant expansion program of the corporation. His automotive experience includes association with Packard, Hudson and Towson Body Company. Mr. Nagelvoort has not announced his future plans.

Charles H. Widman, vice-president and director of sales of the Murray Corp. of America, accompanied by Mrs. Widman, sailed for Europe aboard the Bremen, Oct. 5. Mr. Widman will meet C. W. Avery, president of the company, who sailed for Europe last week with Mrs. Avery and their daughter Anabel. The two executives will visit the London and Paris automobile shows and will spend some time traveling about the continent studying the trend of automobile body construction. They will sail for home about Nov. 1.

Heminway is Honored

M. L. Heminway, managing director of the Motor and Equipment Association, has been elected president of the American Trade Association Executives for the coming year. Mr. Heminway was one of the founders of the association, which is an organization of over 500 managers of trade associations in the United States, and had been a member of the executive committee for five years, serving as vice-president for one year prior to his election.

Gormely is Promoted

Francis P. Gormely, vice-president and general manager of the Haynes Stellite Co., at Kokomo, has been appointed vice-president and general manager of the Union Carbide Co. and the Electro Metallurgical Co., according to announcement made at Indianapolis. The Union and Electro companies are two of the largest subsidiaries of the Union Carbide & Carbon Corp., to which Stellite also belongs.

Glick Joins New Era

Phillip P. Glick, formerly production manager of the Moon Motor Car Co., has resigned to become production supervisor of New Era Motors, Inc. Mr. Glick is stationed at the plant of the Gardner Motor Car Co., St. Louis, where the first "Ruxton" cars, New Era product, are being assembled.

Grose to Visit U. S.

W. T. Grose, managing director of Equipments, Ltd., London, England, will attend the Motor and Equipment Association show in Chicago, arriving there Tuesday, Nov. 5. Mr. Grose is interested in English companies handling the sale of accessories and garage equipment to manufacturers and wholesalers. His itinerary includes Detroit and New York, as well as Chicago.

General Motors Announces Movements of Executives

G. K. Howard, regional director of the European staff of the General Motors Export Division, who has been here on a vacation and visit to the home office, sailed for Paris Oct. 5. He was accompanied by his family.

E. A. Callanan, regional sales manager of the European Staff of the General Motors Export Division, who has been here attending the Regional Sales Managers' Conference, sailed for Paris Oct. 5. Mr. Callanan was accompanied by his family.

L. J. Hartnett, export sales manager of Vauxhall Motors, Ltd., arrived in New York Oct. 8 for a short visit to the home office. He is accompanied by his family.

H. J. Macpeak, who has recently been appointed regional analysis manager of the South American staff of General Motors Export Division, sailed for Buenos Aires Oct. 5. Mr. Macpeak was accompanied by his family.

C. T. Coleman, manager of the Truck and Bus Division, will sail for Berlin Oct. 12. Before returning to New York Mr. Coleman will visit several of the European operations of the General Motors Export Division.

R. B. Johnson, paint specialist of General Motors Java, arrived in New York Oct. 2 for a new assignment. Mr. Johnson was accompanied by his family.

J. Montanye, service manager of General Motors France, arrived in New York Oct. 1 for a visit to the home office.

J. W. Irwin, plant engineer of General Motors Argentina, arrived in New York Oct. 2 for a new assignment. Mr. Irwin's family accompanied him.

Russell Visits Distributors

T. A. Russell, president of Willys-Overland, Toronto, is at present in the Maritime Provinces surveying the territory, and while there will make calls on Willys-Overland distributors.

MacManus Allies With Graham

Theodore F. MacManus, widely known advertising man and author of numerous business books and pamphlets, will become associated with the three Graham Brothers on the first of January.

Wheeler Transferred

C. T. Wheeler has been transferred from Seattle to Spokane, Wash., to take charge of the direct factory branch of the Fisk Tire & Rubber Co. He succeeds M. B. Purdy.

Allbestos Corp. Promotes Three Representatives

W. J. Stansbury, for four years a representative of Allbestos Corp., nationally known manufacturer of Allbestos Brake Lining, has been made District Manager of the Philadelphia territory. He will be assisted in working this territory by P. J. Welsh.

C. A. Prettyman, another veteran employee, will be advanced to the position of New York State District Manager. His headquarters will be in Syracuse.

J. T. Morris has been promoted to the heart of automotive activities from the Philadelphia territory. He will work the states of Michigan, northern Ohio, northern Indiana and northeastern Illinois. Detroit will be his headquarters.

Forsythe Succeeds Coleman

DETROIT, Oct. 7—Silas C. Coleman has resigned as secretary of the Wilcox-Rich Corp. and Richard A. Forsythe, a Detroit attorney, has been appointed to assume his duties. Mr. Coleman's activities were centered at the Rich Steel Products Division of the corporation at Battle Creek, Michigan.

Kelly and Ashton Promoted

R. E. Kelly, formerly manager of the Boston office of the Independent Pneumatic Tool Co., has been made sales engineer for the eastern district with headquarters in New York. He has been succeeded at Boston by John Ashton, formerly a salesman in the New York district.

Reuter Sails for Europe

I. J. Reuter, president and general manager of the Olds Motor Works and a vice-president of General Motors Corp., sailed Oct. 4 for Europe to spend six weeks on a trip of inspection of the Opel properties at Russelsheim, Germany. It is understood that he will return about Nov. 15.

McCarthy Succeeds Lowther

H. C. Lowther, general sales manager of the Goodyear Tire & Rubber Co., of Canada, has resigned from his position and J. D. McCarthy has been appointed to the vacancy. The new general sales manager has been with the company since 1913.

Sherrard Advanced

W. E. Sherrard has been appointed manager of the new factory branch of the Sterling Motor Truck Co., at Spokane, Wash. The branch will be a distribution point for the Inland Empire and Montana territories.

Steel Mills Note Shift in Demand

Automotive Plants Buying Sheets Rather Than Strip

NEW YORK, Oct. 10—Like all branches of the steel industry, mills specializing in full-finished automobile sheets have had to scale their operating rate downward in keeping with the shrinkage in demand. It is, however, a notable fact that these specialists in high-grade body stock were among the last of the finishing mills to feel the full effect of the recession in demand. Strip mills have had to contend of late to some extent with a shift from strip-steel back to sheets by motor car manufacturers who adopted the combined fender and apron which combination calls for widths in excess of those rolled by strip mills.

A good deal is being made of occasional concessions of $1 or $2 a ton in black sheets, and such instances are emphasized as denoting a general slipping of the market. As a matter of fact, attractive specifications frequently were accorded such concessions while the demand was still near its peak. It is possibly true, however, that the interpretation of what is a highly desirable order is today somewhat more in buyer's favor than it was then, but on the whole steel prices are holding fairly steady.

The explanation for this is not far to seek. Prevailing price levels are not a legacy from a period of sharp advances. There was no rise in prices during last summer's heavy demand. This moderation proved a good business stroke because the resulting heavier tonnage made possible production economies. In some quarters it is thought that on certain descriptions of steel permanently lower production costs may have been achieved, but that this has been fully discounted by keeping prices on an even keel during the heavy demand of the summer. This would imply that producers will show energetic resistance to attempts to depress prices during the present lull.

Pig Iron—Automotive foundries are following the market's developments without taking very much of a part in the routine buying movement that is under way. Prices are holding steady all along the line.

Aluminum—Market conditions show no change. Imports from Europe are along routine lines, the import figures shown in the Treasury Department's statistical returns being largely made up of shipments from the domestic producer's affiliated plant in Canada. Demand for remelted metal is quiet.

Copper—Domestic demand is quiet, but export shipments are somewhat heavier. Fabricating plants are feeling the effect of the slowing down in the automotive industries. Prices are unchanged.

Tin—Following a pronounced spell of weakness, the speculative element in London came to the market's rescue and somewhat more support is in evidence.

Budwig Will Handle Aircraft Licenses

WASHINGTON, Oct. 9—Clarence M. Young, assistant secretary of commerce in charge of aeronautics, has announced the appointment of Capt. Gilbert G. Budwig as assistant director of aeronautics in charge of licensing aircraft and airmen. During three years the department has received 86,000 requests for licenses and renewals, said Mr. Young, in announcing the appointment.

Detroit Registrations Below Last September

DETROIT, Oct. 7—For the first time in 1929 new passenger car registrations fell below the 1928 level last month, with September sales totaling 7075, as compared with 9095 in the same month last year. In each of the first eight months this year there was a decided gain over the corresponding month of 1928, and in May the gain exceeded 100 per cent, when May, 1929, registrations were 20,512, as compared with 10,168 in May, 1928.

The total sales for the first nine months of this year were 104,302, showing a gain of 36,098 (nearly 53 per cent) over the total of 68,204 passenger car sales in the first nine months of 1928. The total of 7075 for last month shows a drop of 833, or slightly more than 10 per cent, from the total of 7908 for September, 1928. Local dealers attribute the downward tendency last month to the unprecedented sales record of the preceding 8 months, in a large measure. Ford sales accounted for 33 per cent of the September total, registrations of this make of car being 2336. Chevrolet sales last month showed a total of 889, while Buick ranked third on the list with sales of 718 cars.

Sales of commercial cars and buses last month totaled 948, bringing the total for the first nine months of the current year to 8324, as compared with 4565 in the corresponding period last year.

Allied Die Casting Corp. Occupies New Building

NEW YORK, Oct. 7—The new plant of the Allied Die-Casting Corp., at Long Island City, N. Y., contains 75,000 ft. of floor space, on four levels, according to an announcement made by the company. Plans for the equipment of the new building include an engineering and metallurgical laboratory, and mechanical handling units designed to permit maximum efficiency of plant layout.

Throughout the building the pipe lines are painted different colors so that they can be easily identified and traced. In addition, all piping is grouped and placed in a pipe-galley, which has doors for easy access.

Business in Brief

***Written by the Guaranty Trust Co., New York, exclusively for* AUTOMOTIVE INDUSTRIES.**

NEW YORK, Oct. 10—The heavy rains in some sections of the country last week were somewhat harmful to business. Jobbing and wholesale trade was at about the same level as during the preceding week. There has been fair activity in the cotton-goods markets, with prices firm.

CRUDE OIL PRODUCTION

The average daily crude oil production for the week ended Sept. 28 was 2,900,400 barrels, as compared with 2,924,500 barrels for the week before and 2,509,800 barrels a year ago.

Production of bituminous coal during the week ended September 21 amounted to 10,867,000 tons, as against 10,863,000 tons in the preceding week and 10,021,000 tons in the corresponding week last year.

BROKERS' LOANS

Despite the heavy liquidation on the stock market, brokers' loans in New York City during the week ended Oct. 2 increased $43,000,000. There has been an increase every week since the week ended Aug. 14, and during this period the total has increased almost $1,000,000,000.

COMMERCIAL FAILURES

The number of commercial failures during September, according to R. G. Dun & Co., was 11 per cent below those in the preceding month and 4.1 per cent below those a year ago. The number of failures in September was the lowest for that month since 1926, but the liabilities involved were 0.6 per cent above those a year ago.

CAR LOADINGS

Railway freight loadings for the week ended Sept. 21 totaled 1,166,330 cars, which marks an increase of 22,199 cars over those in the corresponding week a year ago and an increase of 39,928 cars over those in the corresponding week two years ago.

FISHER'S INDEX

Professor Fisher's index of wholesale commodity prices for the week ended October 5 stood at 94.7, the lowest so far this year, as against 95.8 the week before.

FEDERAL RESERVE STATEMENT

The consolidated statement of the Federal Reserve banks for the week ended Oct. 2 showed increases of $58,900,000 in holdings of bills bought in the open market and of $34,500,000 in member bank reserve deposits, while there were decreases of $13,800,000 in holdings of discounted bills and of $6,300,000 in holdings of Government securities. The reserve ratio on Oct. 2 was 72.7 per cent, as against 73.8 per cent a week earlier.

Recession is Felt in Plant Building

Additions Continue to Lead Outlay by Automotive Manufacturers

PHILADELPHIA, Oct. 10—A seasonal recession is being felt in the building industry, insofar as the automotive industry is concerned. Announcements of several major construction projects are expected during the next few weeks, however.

Additions to plants continued to be the most important factor in automotive construction expenditures during the week.

Cutler-Hammer Mfg. Co., New York (electrical control equipment), to build six-story addition to plant at Southern Boulevard and 144th St., to cost $300,000 with equipment. (Headquarters and main plant at Milwaukee.)

William A. Lacerenza, Brooklyn architect, plans a one-story service and repair garage, to cost $100,000 with equipment.

Samuel Galkin Co., Providence (automobile sheet metal works), to start one-story and basement repair shop addition, 46 x 100 ft.

Houde Engineering Corp., Buffalo (shock absorbers), arranging expansion program to cost $200,000.

Lamont Gear & Machine Co., Inc., Philadelphia, leased building for parts production and assembling.

Good Lines, Inc., Camden, N. J. (O. H. Higginbotham), purchased five-acre tract at Hi-Nella, N. J., as site for new plant to manufacture airplanes. Plant will cost $65,000 including equipment.

Pittsburgh Metal Airplane Co., Pittsburgh (Pittsburgh Aviation Industries Corp.), occuping part of former plant of American Car Co., will increase facilities for manufacture of all-metal cabin aircraft. Company recently acquired Thaden Metal Aircraft Co., San Francisco. H. V. Thaden is chief engineer.

Columbia Axle Co. (automobile axles, etc.), considering addition, to cost $40,000 with equipment.

Woods Brothers, Inc., Kansas City, Mo., manufacturer of airplanes and parts, plans plant at St. Joseph, Mo., for parts production and assembling, to cost $55,000 with equipment.

National Garage Co., Kansas City, Mo. (Harry A. Rubin, president), plans story and double basement service and repair garage, to cost $55,000 with equipment. (Charles A. Smith, architect.)

Hastings Mfg. Co., Hastings, Mich. (automobile equipment, etc.), will erect addition, to cost $85,000 with equipment.

Chrysler Corp., Detroit, approved plans for machine shop to cost $85,000 with equipment.

Detroit Steel Products Co. has begun new plant group to cost $500,000 with equipment.

Bendix Aviation Corp., South Bend (accessories for airplanes and automobiles), has approved an expansion program to cost more than $600,000, including erection of several factory units.

Dayton Airplane Engine Co., Dayton (aircraft engines and parts), contemplates expansion program to cost over $400,000. Company has purchased Eastern Aircraft Corporation, Pawtucket, R. I., manufacturer of all-metal airplanes of German (Messerschmitt) type, and will operate as a unit of organization.

Pritchett-Thomas Co., Nashville, Tenn., has awarded general contract to Foster & Creighton, for six-story and basement automobile service and repair garage, to cost $450,000 with equipment. Marr & Holman, architects.

Firestone Tire & Rubber Co., Akron, Ohio, plans branch, storage and distributing plant at Eugene, Ore., to cost about $100,000 with equipment.

Oils and Fuels Topics at Pa. Section Meeting

ELIZABETH, N. J., Oct. 9—Oils and fuels from the standpoint of the refiner and user were discussed here today before a gathering of 300 members and guests of the Pennsylvania Section, Society of Automotive Engineers, assembled at the Hotel Winfield Scott. J. P. Stewart presided.

The papers read were: "Laboratory Testing of Motor Oils and Fuels Under Summer and Winter Conditions," by Dr. A. E. Becker and W. C. Bauer, of the Standard Oil Co. of New Jersey; "Gum in Gasoline," by E. B. Hunn, A. J. Blackwood and H. G. M. Fischer of the Standard Oil Co. of New Jersey Development Corp.; "The Practical Significance of Fuel Knock Rating," by Earl Bartholomew, director, Ethyl Gasoline Laboratories, Detroit, and "Fuel Specifications From the Purchasers' Standpoint," by Adrian Hughes, Jr., superintendent of bus transportation, the United Railways & Electric Co., Baltimore.

The party visited the plant and laboratories of the Standard Oil Co. of New Jersey Development Corp.

Reynolds Spring to Vote on Purchase of Premier

DETROIT, Oct. 9—It was announced this week, that stockholders of the Reynolds Spring Co. of Jackson, Mich., will hold a special meeting on Oct. 24 to vote on a proposed increase in authorized common from 500,000 to 1,000,000 shares and to act upon the proposal of the directors to purchase all outstanding stock of the Premier Cushion Spring Co., Detroit, for $700,000.

Following the company's semi-annual statement which disclosed a net profit of $127,651 after taxes and depreciation, the directors acted favorably upon the recommendation of Charles G. Munn, president, to acquire a spring plant in Detroit in order to serve the motor car manufacturing plants here for which the Reynolds Co. is producing springs.

To Make Aluminum Seats

DETROIT, Oct. 9—Laboratory experiments are being carried on by the American Aluminum Co. at its Buffalo plants under an arrangement with the Ypsilanti Reed Furniture Co. of Ionia, Mich., for the future production of aluminum bus and airplane seats at the Ionia factory, according to Fred A. Chapman, president of the Reed company. A growing demand for seats of lighter material for bus and airplane has developed, it was said.

Output Will Reach 5,600,000—Reeves

N.A.C.C. Manager Predicts Curtailed Program in Detroit Address

DETROIT, Oct. 10—Automobile production this year will reach 5,600,000 passenger cars and trucks, or a million more than the 1928 totals, according to Alfred Reeves, general manager of the National Automobile Chamber of Commerce. In making this prediction before the Rotary Club yesterday noon, he said that the industry expects the usual autumn recession in many production schedules but that the outlook for 1930 is excellent.

"About this time every year since I can remember," said Mr. Reeves, "we hear gloomy forecasts about the motor industry. But there are some important indications that the basic condition in the industry has never been as sound as at present.

"With the extraordinary production of the past nine months, it was high time that manufacturers trimmed their schedules," he continued. "We couldn't expected to maintain a 6,000,000 pace, equivalent to 45 miles of motor vehicles every working day, because it was too fast for our dealers to handle.

"To claim, as certain railroad economists have done, that the commercial vehicle should be taxed to make its levies comparable with railroad taxes and roadbed maintenance, is a fallacy. The courts have held that the government has no right to use its taxing power to regulate competition.

"Great caution should be observed in any additions to motor taxation," he continued. "Every year the legislators see an opportunity to get additional funds, and the trend in taxation has been continually upward. Michigan, for example, now takes in $20,000,000 in license fees and $18,000,000 in gasoline taxes."

Mr. Reeves also said that wholesale forcible insuring of a population is dangerous because the irresponsible man may become more so when he feels that the insurance company will take care of his troubles. Liability insurance has many advantages but the question of general compensation to the public has not yet been sufficiently studied or tried out to prove an ideal plan. Certain states seem to have been over-hasty in adopting various insurance laws which do not prevent accidents but try to force all motorists to take out high-rate insurance because of a limited percentage of reckless drivers.

Durant Production Increased

NEW YORK, Oct. 8—Production of six-cylinder cars by Durant Motors since the present management assumed control is more than double the number built in 1928, according to figures just made public.

Central American Road Conference Plans to Discuss Connecting Highway

WASHINGTON, D. C., Oct. 7—Highway problems confronting countries of Central America, including the question of United States cooperation in surveying the route of the Inter-American Highway, are to be discussed at the Central American Road Conference which opens today in Panama City, according to a program announced today by the Pan American Confederation for Highway Education. Invitations to the conference have been sent to all Central American republics and Mexico, and material progress is expected to be made in the solution of many mutual road problems.

The conference has been called by the government of Panama to coincide with the arrival of the United States delegation which attended the Second Pan American Congress of Highways at Rio de Janeiro during August. Since leaving Rio the delegation has made a series of visits to South American countries where they have conferred with government officials and other prominent leaders in connection with highway matters.

The delegation, which will return to the United States about Nov. 1, is composed of J. Walter Drake, former Assistant Secretary of Commerce, chairman; Representative Cyrenus Cole of Iowa; Thomas H. MacDonald, chief of the United States Bureau of Public Roads; Frank T. Sheets, chief highway engineer for Illinois; H. H. Rice, treasurer of the National Automobile Chamber of Commerce; and Frederic A. Reimer, president of the American Road Builders' Association. Senator Tasker L. Oddie of Nevada, also a delegate to the Rio Congress, returned to this country early in September to attend to legislative matters.

One of the big questions around which much discussion will center is the construction of the Central American link of the Inter-American Highway. While a number of countries, such as Panama, El Salvador and Mexico, already have begun construction of their sections, having even finished several long stretches, others are meeting with financial and technical difficulties and it is to solve these that strenuous efforts will be made by all delegates to the conference.

That stretches of the Pan American Highway are rapidly being built and extended and that within a comparatively few years the major portion of this undertaking will have been completed, has been ascertained by a survey made by the American delegation on its trip from Rio through Argentina and up the west coast of South America. In the countries of Peru and Chile alone, the delegation found there now exists a highway paralleling the coast which starts at Santiago, Chile, and continues northward with but minor breaks to within a short distance of the northern border of Peru.

International Rules Reset By Sporting Commission

PARIS, Oct. 7 *(Special)*—Adopting the proposal of the American Automobile Association, the time limit of 24 hours and the distance limit of 30,000 miles were wiped out by the International Sporting Commission at its meeting held in this city yesterday. It was further decided to make this measure retroactive from Sept. 1, 1929. Under this new ruling world's records can be established for unlimited periods in stages of 24 hours after the first 24 hours, and for any distance in stages of 5000 miles and 5000 kilometres. The American delegates at the congress were W. F. Bradley, representing the Contest Board of the A.A.A., and Wm. S. Hogan, representing the Automobile Club of America.

Major events next year are to be run under the limited gasoline rule, as in 1929. The only event held under this rule last year was the French Grand Prix, and as a consequence the world's championship was not awarded.

The commission decided that vehicles propelled by air screws or rockets should not be eligible for automobile records. The Leroy-Brillie photo-electric timing apparatus, which has been under observation in European races and records for the past two years, was adopted by the commission, subject to a certificate being issued by a French State laboratory. With this apparatus a beam of light thrown across the track is broken by the passage of the car and the time recorded on an endless band. In various tests the maximum variation compared with existing timing appliance was 0.01 second.

Sparta Earns $6.42 a Share

DETROIT, Oct. 7—The Sparta Foundry Co. of Sparta, Mich., maker of piston rings, reports net profits of $320,693, equal to $6.42 a share on 50,000 common shares during the first eight months of this year. Earnings for the entire year of 1928 were equal to $3.17.

Pratt & Whitney Adds Stations

HARTFORD, CONN., Oct. 7—Twenty-four authorized service and parts stations located all over the United States have been established by the Pratt & Whitney Aircraft Co., according to an announcement by C. W. Deeds, sales manager.

New Prest-O-Lite Plant Opened

GRAND RAPIDS, MICH., Oct. 7—A new Prest-O-Lite acetylene gas plant has just been placed in operation here by the Prest-O-Lite Company, Inc.

Rubber Growers See Price Stabilization

Seiberling Announces Agreement to Stimulate Planting

NEW YORK, Oct. 7—A conference of rubber growers in London recently formulated plans for the stabilization of rubber at a price which will stimulate planting, according to F. A. Seiberling, who returned from Europe Oct. 4. The plan was unanimously approved by 25 members of the Rubber Growers Association who attended the conference.

Mr. Seiberling confirmed a report that his company would engage in European production by announcing that the interests of the Seiberling Rubber Co. would be joined with those of the Fulda Rubber Co., Fulda, Germany, so far as European production is concerned.

These announcements come in the face of reports from London that the rubber market has been more active with a declining tendency in prices, after unexpectedly large Malayan and Ceylon shipments. A leading London agency reports that American buyers are not covered on quantity requirements for the spring trade and for further forward delivery. Large volume buying is still to be done, and if producers do not indulge in panicky selling, all rubber coming forward should be wanted in the first half of 1930, says the agency.

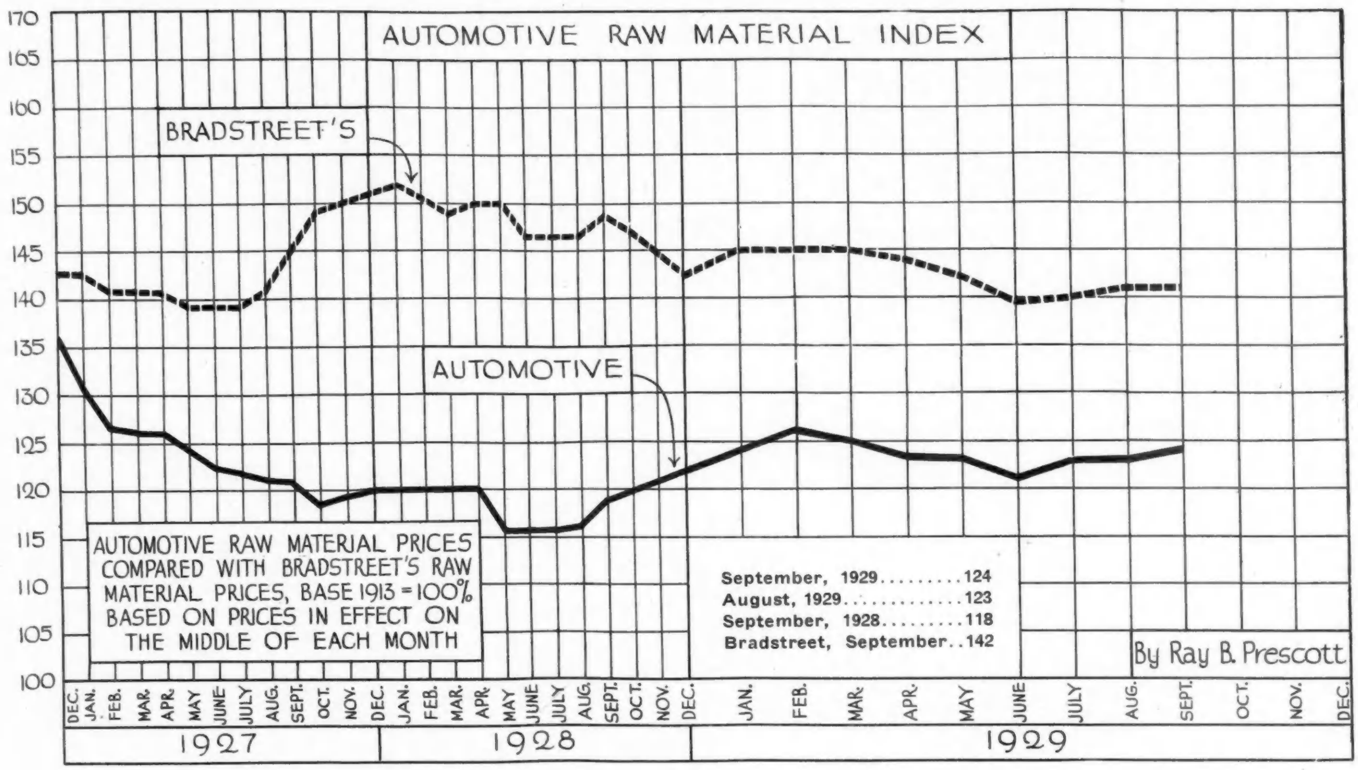
Elcar Offers Four Series of New Cars

ELKHART, IND., Oct. 9—Adoption of a Warner four-speed transmission in the two higher priced lines, together with new body styles, characterizes the Elcar 1930 offering introduced this week. Four series are continued: the 75 six-cylinder line without mechanical change; the 95 and 96 series (the larger of which is regularly equipped with the four-speed transmission, which is optional on the smaller), and the 130 series which replaces the 120 series for 1929.

Prices in the three smaller series remain the same as formerly, while in the 130 series prices have been reduced from $250 to $650. The engine in the 130 series has been increased 1/8 in., thus raising the piston displacement to 322 cu. in. and increasing the actual brake horsepower from 115 to 140 at 3300 r.p.m.

Hood lines have been rounded in all four series for 1930. Roof lines are curved at the back and a new beaded molding extends all around the body below the window reveals. Front seats are adjustable on all sedan models. Wire wheels with two spares, fender-mounted, are offered at extra cost.

Raw Material Prices Rise One Point



Amtorg Placed Orders at Cleveland Tool Show

NEW YORK, Oct. 8—I. M. Markoff, vice-president of Amtorg Trading Corp., announced today that more than $6,000,000 worth of machine tools have been purchased by the Soviet organization during the year ending Sept. 30.

He said that 160 firms participated in the sales. Mr. Markoff headed a delegation of 53 executives and engineers who attended the Machine Tool Show and Congress in Cleveland last week.

M. Dibbetz, president of the Automobile Plant Construction Bureau and an executive of the large Nizhni Novgorod project, reported that the major part of the first unit of the automobile plant had been provided for by the recent acquisition of tools.

"Although our engineers have visited the largest tool manufactories in the world, we found the Cleveland exposition by far the most interesting," Mr. Markoff said.

Central Alloy Purchases Interstate Steel Plant

MASSILLON, OHIO, Oct. 7—F. J. Griffiths, chairman of the Central Alloy Steel Corp., today announced his company's acquisition of the entire property, assets and business of the Interstate Iron & Steel Co., Chicago.

Acquisition of the Interstate properties adds approximately $17,000,000 to the assets of the Central Alloy Steel Corp., making a total of more than $92,000,000. The aggregate ingot capacity of the Massillon company with the addition of Interstate's 396,000 tons, will be 1,938,000 tons. Central Alloy plans to develop and expand the Interstate properties to a considerable extent.

H. H. Collins

CINCINNATI, Oct. 8—H. Harold Collins, 29 years old, inventor of an automobile parking device and a starter for airplanes, died at the Bethesda Hospital here today following a week's illness with pneumonia. Despite his comparative youth, Collins was widely known as an inventor and was associated with the Underwriters' Laboratories, Inc., of Chicago, in their Cincinnati office.

Budd Profits Reported

PHILADELPHIA, Oct. 8 — Budd Wheel Co. of Philadelphia and Detroit, according to Edward G. Budd, president, reports net profits after all deductions, including income tax, interest charges and liberal reserves, for the first eight months of 1929 of $1,587,558. This is equivalent after deductions for preferred dividends paid and accrued, to $6.60 a share for the eight months on the 225,515 shares outstanding.

Auto-Lite to Build in Canada

SARNIA, ONT., Oct. 8—The Electric Auto-Lite Co. will erect a $500,000 plant here to serve Canadian automobile manufacturers, it has been announced. Operations are expected to begin within the next week.

Rubber Exchange Traded 470,330 Tons in Year

NEW YORK, Oct. 9—Futures contracts representing 470,330 tons valued at approximately $217,000,000 were traded in on the Rubber Exchange of New York during the fiscal year ended Aug. 31 last, it was announced yesterday at the annual meeting of the exchange. The volume of trading on the exchange compares with an estimated consumption of 490,000 tons for the United States for the year 1929.

Deliveries of physical rubber on exchange contracts showed an increase of 24 per cent over the previous year amounting to 19,842½ tons. During the year there were 62 quality arbitrations, eight quality appeals and two technical appeals.

Sample Trucks Tested

WASHINGTON, Oct. 8—The Bureau of Standards recently made service tests of sample motor trucks which are to be supplied on annual contract to the Post Office Department. The latest trial was conducted with a truck of six tons capacity and consisted of testing the stopping and holding power of the brakes, the cooling capacity of the radiator when climbing a steep grade, the safe speed of the engine and the operating characteristics of the vehicles.

Goodyear Plans Argentine Plant

NEW YORK, Oct. 8—Representatives of the Goodyear Tire & Rubber Co. announced recently that the company has decided to establish a factory at La Plata, Argentina.

Exports, Imports and Reimports of the Automotive Industry for August of Current Year, and Total for Eight Months Ending August, 1929

	Month of August 1928 Number	1928 Value	1929 Number	1929 Value	Eight Months Ending August 1928 Number	1928 Value	1929 Number	1929 Value
Automobiles, parts and accessories	..	$46,897,612	..	$35,847,145	..	$340,260,716	..	$421,981,562
Electric trucks and passenger cars	3	2,594	5	5,880	84	103,220	110	162,695
Motor trucks and buses except electric (total)	16,193	10,128,347	20,706	10,059,584	87,926	59,105,773	149,870	84,071,146
Up to 1 ton inclusive	11,831	5,628,732	17,104	6,776,136	66,365	33,718,097	114,897	49,850,472
Over 1 and up to 2½ tons	4,053	3,771,111	3,319	2,594,086	19,409	20,125,169	32,153	27,932,592
Over 2½ tons	309	728,504	283	689,362	2,152	5,262,507	2,820	6,288,082
PASSENGER CARS								
Passenger cars except electric (total)	32,015	22,558,806	22,123	14,558,430	265,254	186,476,761	270,818	184,721,032
Low price range up to $1,000	24,381	12,765,404	16,741	8,132,957	210,389	113,943,255	207,062	106,197,626
Medium price range over $1,000 to $2,000	6,662	7,397,752	4,874	5,184,198	47,277	53,703,545	55,935	60,657.387
High price range over $2,000	972	2,395,650	508	1,241,275	7,588	18,829,961	7,421	17,866,019
PARTS, ETC.								
Parts except engines and tires	..	..	..	..	..	..	..	..
Automobile unit assemblies	..	6,863,422	..	5,699,102	..	42,220,845	..	87,619,684
Automobile parts for replacement	..	5,276,004	..	4,331,044	..	35,441,834	..	49,522,230
Automobile accessories	..	822,537	..	652,935	..	6,319,622	..	7,049,726
Automobile service appliances (n. e. s.)	..	521,591	..	695,127	..	4,925,137	..	5,279,856
Trailers	56	38,619	127	47,951	481	203,512	697	318,681
Airplanes, seaplanes and other aircraft	14	135,477	24	375,933	117	1,307,936	240	3,965,129
Parts of airplanes except engines and tires	..	108,721	..	191,044	..	879,365	..	1,475,288
BICYCLES, ETC.								
Bicycles	300	8,565	533	13,453	3,297	89,003	3,689	94,616
Motorcycles	2,031	479,931	745	168,433	13,698	3,184,062	12,088	2,748.236
Parts, except tires	..	155,482	..	79,927	..	1,018,171	..	774,576
INTERNAL COMBUSTION ENGINES Stationary and Portable								
Diesel and Semi-Diesel	26	78,791	21	38,770	250	705,860	252	620,471
Other stationary and portable:								
Not over 10 hp.	3,498	284,451	2,895	245,170	25,118	2,173,326	25,393	2,238,267
Over 10 hp.	651	253,164	521	206,413	3,266	1,315,783	3,210	1,594,558
Automobile engines for:								
Motor trucks and buses	3,534	278,974	156	38,399	12,864	1,221,065	7,410	1,009,903
Passenger cars	10,261	966,928	3,931	501,771	90,993	9,371,596	75,467	7,825,146
Tractors	41	20,275	52	22,287	353	114,421	601	185,011
Aircraft	34	114,355	9	36,090	117	416,384	237	1,029,453
Accessories and parts (carburetors)	..	272,140	..	312,371	..	2,525,105	..	3,103,581
IMPORTS								
Automobiles and chassis (dutiable)	52	76,022	60	105.989	330	704,082	433	834,613
Other vehicles and parts for them (dutiable)	..	63,650	..	316,903	..	431,501	..	1,452,441
REIMPORTS								
Automobiles (free from duty)	20	30,572	28	23,680	167	193,208	310	371,019

Argentine Field Studied by Commerce Department

WASHINGTON, Oct. 7—The Automotive Division of the Bureau of Foreign and Domestic Commerce has just published "The Automotive Market in Argentina" by Howard H. Tewksbury, automotive trade commissioner to South America. The booklet is No. 84 of the Trade Promotion Series and may be obtained from any district office of the Bureau of Foreign and Domestic Commerce or from the Superintendent of Documents at the Government Printing Office in Washington. The price is 20 cents.

Argentina ranks second as a world market for American automotive products, as Mr. Tewksbury's study points out. The underlying conditions of this market are presented in detail. Argentina as a market for passenger cars, trucks and replacement parts is analyzed. The market by provinces, the highway systems, and the future transportation needs of the country, all find a place within the 106 pages of "The Automotive Market in Argentina."

Brewer Awards Contract

CORTLAND, N. Y., Oct. 7—The Brewer-Titchener Corp., manufacturer of automotive parts, has awarded the Austin Co. a contract for the design and construction of three new units, constituting a plant expansion costing about $225,000.

The new buildings will be a 60 by 80-ft. machine shop, a 70 by 100-ft. forge shop, and a 34 by 72-ft. storage shed. All will be of steel, brick and concrete construction, one story.

Completes Nitriding Furnace

MASSILLON, OHIO, Oct. 7—The Central Alloy Steel Corp. has completed construction and started operation of what is said to be the largest nitriding furnace in the world at its Canton works. The new furnace will be utilized to promote the use of nitralloy, one of the new alloys being produced by the company under Krupp licenses. The automotive and aviation industries are adopting nitralloy for such parts as valve tappets, wrist pins, gears, steering sectors, crankshafts and camshafts.

Chris-Craft Plant Expanding

ALGONAC, MICH., Oct. 7—The marine motor plant of the Chris Smith & Sons Boat Co. is being doubled in capacity by the addition of 10,000 sq. ft. of floor space. According to the company this will permit a production of 1200 Chris-Craft Marine Motors during the next year.

Plymouth Has New Model

DETROIT, Oct. 7—A new De Luxe sedan with new features is being announced this week by the Plymouth Motor Corporation. This new sedan increases the number of body styles available in the Plymouth line to seven and it is priced at $745 f.o.b. Detroit.

New Federal Plant Operating

DETROIT, Oct. 7—The new $300,000 foundry and new 26,400 sq. ft. addition to the factory of the Federal Mogul Corp., manufacturer of bearings, bushings, bearing metals, die casting and allied products are now in full operation. Thus, all departments of the company are brought to one location rather than at two plants as heretofore. The expansion brings total area of more than 100,000 sq. ft. available for production.

McAleer Sales Nearly Double

DETROIT, Oct. 7—Sales of the McAleer Manufacturing Co., producers of polishing products used by 92 per cent of all automobile manufacturers, during the last half of 1929 will triple those of the corresponding period of 1928, according to Tom Walton, vice-president in charge of sales. McAleer shipments for the first half of 1929 surpassed those of the first half of 1928 by 100 per cent. Profits have increased in proportion, according to Mr. Walton.

Micromatic Organization Complete

DETROIT, Oct. 7—Following reorganization and recapitalization on a substantial basis, the name of the Jeschke Tool Corp., of this city, has been changed to the Micromatic Hone Corp. Frank Jeschke and G. M. Calvert will continue to devote their entire time to development and engineering service, according to the company's announcement. K. W. Connor is president of the newly organized corporation.

Australian Firm Plans to Build New Six Car

WASHINGTON, Oct. 7—A company to be known as the "Australian Made Motor Cars & Aeroplanes, Ltd.," with a capital of £2,000,000, is being formed in New South Wales to build an all-Australian six-cylinder automobile designed to meet the peculiar conditions in Australia, according to a report received from Melbourne by the Commerce Department.

The scheme is said to be on a sounder and more ambitious scale than former enterprises of similar character, says the report, although financial journals regard it as speculative.

Another enterprise on a small scale is proposed in Victoria, says the report, where a syndicate known as the Bruce Car Manufacturing Co. is being formed to provide capital to build a light seven-horsepower car of similar design to the English "Century" with an engine similar to the English "Jowett."

McMichael is Promoted

NEW YORK, Oct. 7—Transfer of Hugh B. McMichael, manager of electrical sales for United Motors Service, Inc., to the Overseas Motor Service Corp., broadening his field of activity to cover the organization and supervision of specialized service branches in all parts of the world, has just been announced. Mr. McMichael will leave shortly for Mexico City, where he will begin operations with the organization of a branch to handle the servicing of motor cars and motor car equipment throughout all Mexico.

For the past 10 years Mr. McMichael has been in the United Motors Service organization. When he joined the company it consisted of 13 branches and less than 100 authorized service stations. Today it has 27 branches and more than 5000 authorized service stations and battery dealers. When the organization work in Mexico is finished, Mr. McMichael will move to another quarter of the globe to organize another branch, eventually covering the entire world.

A.A.A. to Begin Safety Education

WASHINGTON, D. C., Oct. 7—There is one motor vehicle registered for every child attending the public schools, and this situation has presented a need for safety education in the schools which can no longer be ignored.

This statement was issued today by National Headquarters of the American Automobile Association on the eve of the greatest safety education program ever attempted in this country, in which the Bureau of Education of the Federal government, the National Education Association and other agencies have been invited to cooperate.

Temple University Offers Metals Course

PHILADELPHIA, Oct. 7—A practical evening course in heat-treatment and the metallography of steel is being offered by Temple University under the auspices of the Philadelphia Chapter of the American Society for Steel Treating. This course has been given for the past seven years and more than 400 steel treaters, purchasing agents, salesmen and engineers are said to have taken it. A grammar school education is all the preparation required.

Finds Gasoline Tax Gains Tremendously in 6 Years

NEW YORK, Oct. 7—Gasoline taxes have increased from an average of only 50 cents per motor vehicle in 1921 to $13 per motor vehicle in 1928, and may reach an average of $17 in 1929, the American Petroleum Institute finds in a survey of the gasoline tax situation.

The aggregate tax has increased from $4,700,000 in 1921, when 10,500,000 motor vehicles were registered, to $305,000,000 in 1928, when 24,500,000 vehicles were registered. Estimating the 1929 registration at 26,000,000 vehicles and the aggregate gasoline tax at $450,000,000, the Institute points out that while since 1921 motor vehicle registrations have not even tripled, the aggregate tax has increased a hundredfold.

Indiana Tax Receipts Rise

INDIANAPOLIS, Oct. 7—Indiana state gasoline tax collections in September showed a gain of $662,103, or 55 per cent, over September a year ago, and the total of $1,852,908 was the largest in the gas tax history in Indiana, according to the state collector. September collections are made on August sales.

An increase of nearly 7,000,000 gal. of gasoline was reported in the September consumption in the state, 46,322,570 gal. being sold.

Budd Door Output High

PHILADELPHIA, Oct. 7—The door plant of the Edward G. Budd Manufacturing Co., makers of all-steel automobile bodies, produced 1,653,732 doors during the first nine months of the current year, according to an announcement by the company. This compares with a production of 1,317,517 doors during the entire year of 1928.

Calendar of Coming Events

SHOWS

Dallas, Automobile .... Oct. 12-27
Atlantic City, Automobile........ Oct. 21-22
Philadelphia, Automobile .... Jan. 11-18
Buffalo, Automobile .... Jan. 11-18
Cincinnati, Automobile .... Jan. 12-18
Detroit, Automobile .... Jan. 18-25
Baltimore, Automobile .... Jan. 18-25
Harrisburg, Automobile .... Jan. 18-25
Louisville, Automobile .... Jan. 18-25
Hartford, Automobile .... Jan. 18-25
Rochester, Automobile .... Jan. 20-25
Columbus, Automobile ...... Jan. 26-Feb. 1
Wilkes-Barre, Automobile ... Jan. 27-Feb. 1
Wichita, Automobile .... Feb. 3-8
Cumberland, Automobile .... Feb. 3-8
Syracuse, Automobile .... Feb. 3-8
Peoria, Automobile .... Feb. 4-8
St. Louis, Automobile .... Feb. 4-9
Denver, Automobile .... Feb. 10-15
Providence, Automobile .... Feb. 14-22
Camden, N. J., Automobile.. Feb. 24-Mar. 1
Des Moines, Automobile .... Feb. 24-Mar. 1
Detroit (All-American Aircraft).. April 5-13
London, Automobiles .... Oct. 17-26
Prague, Automobiles .... Oct. 23-30
Paris, Motorcycles .... Oct. 23-Nov. 3
M.&E.A. Show and Convention, Chicago .... Nov. 4-9
N.S.P.A. Show and Convention, Detroit .... Nov. 11-16
London, Trucks .... Nov. 7-16
Paris, Trucks .... Nov. 14-24
London, Motorcycles .... Nov. 30-Dec. 7
Brussels Auto Salon..................... Dec. 7
New York National................ Jan. 4-11
Newark (N. J.) Automobile Show. Jan. 11-18
Boston Automobile Show......... Jan. 13-25
Chicago National, Coliseum.. Jan 25-Feb. 1
Cleveland Automobile Show.. Jan. 25-Feb. 1

CONVENTIONS

Asbestos Brake Lining Assn., New York .... Dec. 11
Ohio Assn. of Commercial Haulers, Cleveland .... Jan. 30-31
Associated Business Papers, Chicago, Oct. 21-22
Society of Industrial Engineers, Detroit .... Oct. 16-18
National Hardware Association, Atlantic City .... Oct. 21-24
Society of Industrial Engineers, Sixteenth Annual Meeting, Hotel Statler, Cleveland .... Oct. 23-25
National Battery Mfrs. Assn., Hollenden Hotel, Cleveland .... Oct. 24-25
Amer. Gear Mfrs. Asso., Phila... Oct. 24-26
World Engineering Congress, Tokio, Japan .... Oct. 29-Nov. 22
Overseas Club Dinner, Chicago ..... Nov. 6
National Automotive Parts Association, Detroit .... Nov. 6-8
National Tire Dealers Assn., Chicago Nov. 11-14
International Acetylene Assn., Chicago Nov. 13-15
Highway Research Board, Ninth Annual Meeting, Washington, D. C. Dec. 12-13
National Automobile Dealers Association, New York City .... Jan. 6
American Roadbuilders Association, Atlantic City .... Jan. 11-18
National Automotive Dealers Association, Chicago .... Jan. 27-28
Southwest Road Show and School, Wichita .... Feb. 25-28

RACES

American Society Mechanical Engineers, Fiftieth Anniversary Celebration:
New York .... April 5
Hoboken, N. J. .... April 7
Washington, D. C. .... April 8-9
Edsel B. Ford Air Tour, Dearborn, Mich. .... Oct. 5-21
Los Angeles .... Nov. 17

S. A. E.

Transportation Meeting, Toronto. Nov. 12-15
Annual Meeting, Detroit.......... Jan. 21-24

SALONS

Hotel Drake, Chicago .... Nov. 9-16
Hotel Commodore, New York City. Dec. 1-7
Hotel Biltmore, Los Angeles...... Feb. 8-15
Palace Hotel, San Francisco, Feb. 22-Mar. 1